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SCIENTIFIC AND INDUSTRIAL RESEARCH
NEW ZEALAND

BOTANY DIVISION

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DEPARTMENT OF
SCIENTIFIC AND INDUSTRIAL
RESEARCH

BOTANY DIVISION

CHRISTCHURCH - NEW ZEALAND

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FUNCTIONS AND LOCATION

The main function of Botany Division is to study the plants of New Zealand. We seek to describe and classify the native, adventive and horticultural flora, and to describe the vegetation whether old or new, past or present. To facilitate these aims, research is also carried out in genetics, cytology, anatomy, morphology, palynology and ecology. The information obtained is made widely available both here and overseas.

The Division's headquarters is near the township of Lincoln, 23 km south-west of Christchurch in the South Island. There are substations at Auckland, Wellington, Nelson and Dunedin.

THE FIRST FIFTY YEARS: 1928-1978 SYSTEMATIC BOTANIST TO BOTANY DIVISION

E. J. Godley

The New Zealand Department of Scientific and Industrial Research was created in 1926 and an admirable account of the first fifty years has been given by J. D. Atkinson (N.Z. DSIR Information Series 115, 1976). The following is a more detailed account of the development of Botany Division.

Our story begins in August 1928 when Dr H. H. B. Allan (1882-1957), a distinguished amateur botanist and a teacher at the Feilding Agricultural High School, was appointed Systematic Botanist to the Plant Research Station. This was a joint undertaking of the Department of Agriculture and SIR which was established that year in Palmerston North. Allan was joined as Assistant, also in August, by V. D. Zotov (1908-1977)[1], one of his pupils from Feilding[2]. The small wooden house at 21 Princess Street in which they began their work was shown in our Triennial Report, 1969-71. Here Allan worked in the room next to G. H. Cunningham, later first Director, Plant Diseases Division.

Allan donated his private collection of some 3000 specimens to the Station, and these, with the specimens from the old Biological Laboratory of the Department of Agriculture, formed the nucleus of the present Botany Division Herbarium (CHR), which now contains some 300,000 specimens.

The exact terms of reference of the Systematic Botanist are not known, but it is clear that he was to identify plants for the entomologists and mycologists, and also to concentrate on plants considered of practical importance such as grasses and introduced weeds. At that time native plants would have been considered adequately covered because the second edition of Cheeseman's "Manual of the New Zealand Flora" had appeared in 1925.

In December 1931, Mr C. E. Woodhead was appointed "as an Assistant to the Botanist at the Plant Research Station to work in connection with the Fruit Research Scheme of this Department". He conducted trials of a new series of apple, pear and stone fruit rootstocks, introduced from the East Malling Research Station, as well as making a botanical classification of the Northern Spy rootstock used in New Zealand apple orchards, to ascertain if variability in tree performance was due to the presence of strains of this stock.

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[1] See Obituary by Dr A. D. Thomson (*N.Z. Jl. Bot.* 1977).

[2] Both A. J. Healy and N. T. Moar also came from Feilding Agricultural High School.

By 1934 the botanists had moved to better premises in Keeling and Mundy's Building in Rangitikei Street next to the Bank of New Zealand. Mr Alan Reed, then straight from school, recalls that "the rooms were lined with shelves with boxes of botanical specimens, with Doctor Allan in one room and Charlie Woodhead and I in the other" (Zotov was on study leave). He remembers pollinating lucerne plants, collecting ripe pods, and threshing and posting the seeds to California; drying out all specimens when a girl upstairs left a tap running all week-end. (Doctor Allan decided it was his holiday time—a very wise decision); assisting Charlie with budding on to apple and cherry stocks; cycling around Palmerston North collecting flowers, naming them, and extracting their pollen on to microscope slides (the idea to examine honey to determine what type of pollen was present); enviously examining Doctor Cunningham's Lagonda Sports Saloon; and being reminded by Mrs Allan to see that the Doctor changed his coat each morning.

In 1936 Allan's "An Introduction to the Grasses of New Zealand" was published (DSIR Bulletin No. 49) and in the same year the Plant Research Station was transferred to DSIR and renamed Plant Research Bureau. All sections except Botany became Divisions and Mr Woodhead transferred to the new Plant Diseases Division to join workers long active in diseases of fruit trees. Most Divisions were relocated in more suitable parts of New Zealand, with the Botany section moving to Wellington in June, 1937 "to give access to collections in the Dominion Museum" (Atkinson, 1976). In October 1938 the section became Botany Division with H. H. Allan as first Director. The botanists were housed briefly at 129 Sydney Street West, then at 58 Bowen Street from 1938 to 1942, before moving to 8 The Terrace which was the headquarters of the Division until the move to Christchurch in 1954. A memorandum from Dr Allan in August 1939 recommended purchase of 12 acres at Waiwhetu, Hutt Valley, in order to satisfy the immediate need of 5 acres for experimental gardens, and the long term need for expansion and a permanent building site for the Division. In the event 4 acres 1 rood was purchased.

Between the end of the depression and the early war years, Dr Allan recruited a group of botanists, some of whom, with V. D. Zotov, were to form the backbone of the Division for many years to come. Mr A. L. Poole (appointed 1937) surveyed the Moutoua estate, the last large area of native flax in the Manawatu and taken over by the Government in 1938. The invasion of agricultural land by ragwort was studied by Poole and D. Cairns (appointed 1938) and invasion by hard-fern by Miss L. B. Moore (appointed 1938) as part of her work on lower plants. Miss R. Mason (appointed 1939) began with anatomical work and later worked on seeds, the identification of foods of wildlife, and the taxonomy, distribution and ecology of aquatic plants. In 1940 Mr W. R. Boyce was recruited to assist with work

on native flax at Moutoua; and Mr A. J. Healy (appointed 1941) began work on nassella tussock beginning a career in which he became the New Zealand authority on adventive plants. The Division's long continuing interest in the native tussock grasslands began in 1937-38 when V. D. Zotov made a survey of depleted areas in South Island.

Thus the first twelve years of the Botany Section and Division were mainly devoted to economic botany. But parallel with this official work ran what was often called "own work", usually the study of native plants or vegetation, perhaps in conjunction with tramping interests, and leading to valuable publications. In this time the staff increased from 2 to 14, and the period appropriately ended with the publication in 1940 of Allan's "Handbook of the Naturalised Flora of New Zealand" (DSIR Bulletin No. 83).

During the war years the problem of New Zealand's self-sufficiency in many vegetable products was a major concern of the Division. At Waiwhetu we tested strains of medicinal plants (deadly nightshade, thorn apple, opium poppy, castor oil, henbane) and, as a source of rubber, the Russian dandelion and native sow thistle. There was also work on native flax, linen flax, hemp, and cabbage tree leaves for fibres, as well as surveys of sphagnum moss for possible surgical dressings, teasel for the wool industry, sweet brier for vitamins, foxgloves for digitalin and seaweeds for agar and carrageen. The latter work (by Miss L. B. Moore) led to an agar industry which still exists in New Zealand.

In 1942 H. E. Connor began his long association with the Division, involving work on poisonous plants and the ecology, taxonomy and reproductive systems of indigenous grasses. And in 1943 Dr Allan began observations on the depleted tussock grasslands of the Molesworth Station. Early bulletins and papers from Botany Division had often been illustrated by the black and white drawings of V. D. Zotov, but in 1943 Miss N. M. Adams was appointed as Botanical Artist and she and her successor, K. R. West (appointed 1959), have enriched our papers, bulletins and Floras with botanical illustrations of international quality. In 1944 Mr W. F. Harris was appointed as our first palynologist and was soon investigating an outbreak of honey poisoning which occurred in early 1945. Harris was reinforced in 1947 with the appointment of N. T. Moar and work continued on honeys, atmospheric pollens and the quaternary. In 1945 T. W. Rawson was appointed to the herbarium, and in 1947 A. P. Druce for vegetation surveys and J. B. Hair as cytologist. Thus by the time of his retirement in 1948, Dr Allan had built up a staff of 23 with the potential for studying most aspects of the wild plants of New Zealand, excluding physiology. But further development of the Division was hampered by a serious accommodation problem. In his annual report for 1946 Allan noted that, at The Terrace, "the Division still suffers also from being housed in quarters not originally designed for its purpose, and not capable of being really suitably modified.

Even with an inadequate staff the present quarters are insufficient in space". The solution was to proceed with the idea of building at Waiwhetu and plans were completed in early 1948 involving the use of miscellaneous buildings brought from elsewhere.

Dr Allan was replaced by his Assistant-Director Mr A. L. Poole; but before Poole could tackle the problem of a permanent building the question of a suitable locality needed re-examination. The area available at Waiwhetu was clearly too small, and a return to Palmerston North had little to recommend it. Christchurch was finally chosen and reasons given in correspondence were: that tussock-grasslands were now a major interest of the Division; that many of the native plant genera requiring critical taxonomic evaluation were mainly represented in South Island; and that the protection forests of South Island as well as those suitable for management were now the largest and most important in the country. Poole had hoped to locate Botany Division on the proposed new Ilam campus of Canterbury University College but the Council could not grant his request for 10 acres. As only a vague possibility remained of obtaining 1 acre for a building alone, Poole recommended in May 1950 the purchase of 10 acres in north-west Christchurch close to the Ilam campus; and before his appointment as Assistant-Director of Forests a suitable site was found in Greers Road belonging to the Greer Estate.

In January 1951 Mr Poole was succeeded by Mr C. M. Smith, Senior Inspector of Forests, and by June Mr I. F. Bartos of District Office could report the purchase of 10½ acres at Greers Road, followed by smaller additions in subsequent months. To supervise development of the area H. E. Connor transferred to Christchurch in August, 1951, and was housed at District Office, Manchester Street. And a search went ahead for suitable temporary premises in Christchurch. Meanwhile at The Terrace in Wellington the three members of the Palynology section worked in a 17′ × 12′ room at a single table to which the hand operated centrifuge was periodically clamped. Microscope work ceased until spinning was completed. And in a smaller room the Director and Assistant Director (A. J. Healy) did all their administration and research. The herbarium was also hopelessly cramped. The congestion was slightly relieved with the removal of the palynologists to rooms at 180 Lambton Quay in 1951.

There was one more problem to resolve before the Division finally found a permanent home. In 1952 the new Director of Canterbury Agricultural College, Dr M. M. Burns, had offered to sell Botany Division an area of land on which to build at Lincoln. This had been declined with the agreement of Mr F. R. Callaghan, then Secretary, DSIR. The policy was to build at Greers Road. The matter was raised again under the new Secretary, Dr W. M. Hamilton, and discussed at the DSIR Council meeting on 17 July, 1953, which Mr Smith attended and where he opposed the College proposal. However

the advantages of building close to the College and to a related Division won the day and Council resolved on 24 September "that the Botany Division be located at Lincoln and that the offer of Lincoln College Board of Governors to sell the Department 24 acres of this land for this purpose be accepted". This 24 acres, on the corner of Springs Road and Ellesmere Junction Road and adjoining the Crop Research Division, was not in fact used by Botany Division but was traded for the Crop Research Division South Block so that the buildings of the two Divisions could be closer together and a library shared. And Crop Research's East Block, unsuitable for cropping, was transferred to Botany Division.

In early 1954 the headquarters of the Division moved to Christchurch where a two-storey brick house at the SE corner of Latimer Square and Hereford Street had been leased and modified to our needs. This was a pleasant situation and at last staff, library and herbarium were reasonably accommodated. Substations were at Lincoln College where the cytologists J. B. Hair and E. J. Beuzenberg worked in the old Wheat Research Institute building; in Wellington where Miss Moore had remained at The Terrace to assist Dr Allan with the "Flora of New Zealand" which he was writing in his retirement; and at the Dominion Museum, Wellington, where V. D. Zotov remained for a year. Waiwhetu and Moutoua were closed down and W. R. Boyce came to Christchurch. In 1957 the Greers Road property was relinquished and sketch plans were ready for propagating houses at Lincoln and for the new building, mainly through the efforts of Mr I. L. Baumgart of Head Office.

The decade under Mr Poole and Mr Smith saw the choice of Christchurch in general and Lincoln in particular as the Divisional headquarters. Both have proved sensible decisions. Under Mr Poole staff numbers increased, and included the appointment of Miss M. J. A. Simpson and M. H. Bannister. But Bannister (who studied variation in *Pinus radiata*) logically followed Poole to Forest Service. The move to Christchurch lost us many officers because of ties in Wellington. As would be expected all office and gardens staff, and most technicians did not come south. B. G. Hamlin transferred to the Dominion Museum and A. P. Druce transferred to Soil Bureau, DSIR. Of the professional officers W. F. Harris returned to Wellington in August, 1955, to join Soil Bureau and later Geological Survey; and in November, 1955, W. R. Boyce was appointed Superintendent, Levin Horticultural Research Station, Department of Agriculture. Mr Smith soon recruited office and gardens staff (including our first full-time Administration Officer, R. J. L. Sheehy) and appointed a librarian. He replaced all but 3 of the technicians and his Christchurch appointments included E. J. Beuzenburg (transferred from Crop Research Division in 1954) and Bryony Macmillan (appointed 1955). In Wellington Margot Ashwin (appointed 1954) assisted with Flora writing. But there was difficulty in recruiting professional officers to

replace Bannister, Harris and Boyce and only one slot was filled for any length of time viz. B. M. Gilpin (1957-64). In 1957 there were 10 professional officers of whom 9 had been appointed in Allan's time. And whereas on 31.3.52 the total staff was 29 (i.e. 26 + 3 garden staff then graded as technicians), on 31.3.57 the staff was 23 (i.e. 20 + a garden staff of 1 technician and 2 wage workers).

During this time there was an emphasis on tussock-grasslands and grasses, whether surveys in Canterbury, continuation of work at Molesworth, or study of reproductive systems. Work towards a weed Flora continued as did surveys of water plants and studies of pollen both recent and fossil. And contributions to the chromosome atlas were begun. An historic moment was the acquisition of a discarded Ford van from Geological Survey Invercargill—our first Divisional vehicle—to be replaced soon afterwards by a new Bedford Utilicon.

In January 1958 E. J. Godley transferred from Director, Crop Research Division, to succeed Mr Smith on his retirement. In April, A. P. Druce transferred back to Botany Division, remaining at Soil Bureau to start a new Wellington sub-station devoted to survey work in North Island, and he was joined by I. A. E. Atkinson in June. In Christchurch F. J. F. Fisher was recruited to continue his biosystematic work on alpine *Ranunculi*. We finally returned to the staff numbers of 1952 with the recruitment of Elizabeth Edgar in 1959, who began work on *Juncus* for the second volume of "Flora of New Zealand"; of P. Wardle in 1960 who transferred from Forest Service as ecologist; and of W. R. Sykes in 1961 who was to concentrate on the taxonomy and identification of horticultural plants, and later studied the plants of our island territories in the southwest Pacific.

Tony Druce was already working in Egmont National Park, and Ian Atkinson and Margaret Simpson expressed interest in Tongariro and Nelson Lakes respectively. An arrangement was therefore made in 1961 with the Director-General, Department of Lands & Survey that Botany Division should be responsible for a vegetation survey of some of the parks and give botanical advice. In later years Peter Wardle became responsible for Westland National Park and we supervised the survey of Mt Cook carried out by Hugh Wilson on contract to Lands & Survey. This work continues.

At Lincoln the propagating houses were completed in 1958 and work continued in laying out the experimental gardens, first under B. L. Nicholls (appointed 1956) and then, from late 1960, under his successor I. C. Brown (appointed 1958) who has continued as Officer-in-Charge of the Gardens until the present day. The main building was begun in May 1958 and we entered our new home in May 1960. It consisted of three main units: herbarium, library, and a two-storey east wing, the first floor of which housed the Lincoln sub-station of Grasslands Division as well as the sub-station of Entomology Division, transferred from Ashburton. In the herbarium, steel cabinets replaced our traditional cardboard boxes. The

palynologists at last had a proper laboratory, and a new cytology laboratory allowed the cytologists to join us from Lincoln College. In late 1960 Miss Moore also joined us from Wellington having completed Vol. 1 of "Flora of New Zealand" after Dr Allan's death in 1957[1]. This major work was published in 1961.

In the library our period of rapid turnover of librarians had ended with the appointment of Miss Barbara Harris in 1959. When the libraries were combined at Lincoln, Mrs Molly Blackmore, Librarian, Crop Research Division, became Miss Harris's assistant, and succeeded her in 1966. And in 1965 a grant of $48,200 from the Scientific Distribution Committee of the "Golden Kiwi" lottery enabled us to purchase back numbers of periodicals poorly represented in New Zealand. In these and earlier developments we were greatly assisted by Mr E. H. Leatham, Chief Librarian, DSIR. In 1963 the *New Zealand Journal of Botany* began publication as a result of negotiations, begun in 1958, with Head Office, DSIR, for a purely botanical journal for the country. Preliminary stages of editing were carried out at Botany Division by E. J. Godley until 1971 when A. D. Thomson joined us and took over. In 1978 all editing was transferred to Science Information Division.

After a lull in professional officer recruitment, taxonomical research was reinforced by the appointment of D. R. Given (1965) and D. G. Drury (1967), and vegetation survey by the appointment of G. C. Kelly (1965) and B. P. J. Molloy (1969). On the initiative of G. C. Kelly and assisted by his wife, Mrs Diana Kelly (appointed 1969) a biological survey of all Reserves in the country was begun in 1971 in cooperation with the Department of Lands and Survey. The Reserves of the Canterbury Land District were first surveyed followed by those of the Nelson Land District. This survey continues but the remaining land districts are the responsibility of each regional botanist. Of these regional botanists A. P. Druce in Wellington has already been mentioned. From here work was mainly done in the southern North Island and (by I. A. E. Atkinson) on northern offshore islands. A regional botanist for Auckland was obviously needed and A. E. Esler was appointed in 1969 and housed at DSIR Mt Albert. In 1973 because of environmental problems concerning the use of Lake Manapouri, Lake Te Anau, and the Clutha River

[1] To the obituary by L. B. Moore (Proceedings of the Royal Society of New Zealand 1959), we can add that Dr Allan's subjects for B.A. were: 1902, Latin; Pure Mathematics; Mechanics; Jurisprudence and Constitutional History; 1904, English; Mental Science. The degree was conferred in 1905. The examinations for the degree of M.A. in Mental Science were passed in 1906 and the degree conferred in 1908. Mental Science (Psychology, Ethics and Logic) was classified as a science and was Dr Allan's prerequisite for the degree of D.Sc. which was conferred in 1923. (I am grateful to the late Dr L. J. Wild for this information).

for hydro electric power, J. C. Hubbard was appointed in Dunedin, and succeeded in 1975 by P. N. Johnson (appointed 1973); and in 1975 G. N. Park was appointed regional botanist in Nelson, the impetus being the Forest Service proposals for utilisation of beech forests in Nelson-Westland.

In 1969 the electron microscope unit (M. K. Reynolds) of the Plant Diseases Division substation at Lincoln was transferred to Botany Division for easier administration. As well as providing an identification service for viruses and fungi for the whole Lincoln Centre the microscope has been used for studies of pollen grains and latterly by Dr Melva Philipson (appointed 1967) for embryology.

In 1970 the second volume of "Flora of New Zealand" was published, dealing with indigenous monocotyledons except grasses and written by Dr Lucy Moore and Dr Elizabeth Edgar. A third volume was then begun dealing with adventive monocotyledons except grasses, and the authors were A. J. Healy and Dr Edgar. The text was handed to the Government Printer on 27 July 1977. In anticipation of the future when the "Flora of New Zealand" will not make a distinction between indigenous and adventive plants, this volume includes brief descriptions of native species if the genus is represented by natives and adventives.

Between 1968 and 1975 there were several retirements of officers who joined us in the early years of the Division—V. D. Zotov, L. B. Moore, R. Mason, J. B. Hair, and T. W. Rawson. In the consequent rebuilding of staff we brought the Palynology Section back to its 1947-55 strength by the appointment of M. S. McGlone (1972). We also strengthened our work on lower plants with the appointment of M. J. Parsons (1971) as algologist, D. J. Galloway (1972) as lichenologist, and Vivienne Cassie (1975) to work on fresh water algae. As anatomist we appointed R. N. Patel (1975) and the Dunedin substation was reinforced with W. G. Lee in 1976. The appointment of P. Garnock-Jones and C. J. Webb to the Taxonomy Section in 1975 allowed us to spread the load in Flora writing, and in the volume which will deal with adventive dicotyledons the families were divided among four authors.

In 1971 extensions to the library were completed which doubled its size; and in 1973 extensions to the east wing gave us extra offices, as well as anatomy and seed-germination laboratories, the latter designed to her requirements by Mrs M. J. A. Bulfin (née Simpson). On the first floor were extra offices and laboratories for the substations of Entomology and Grassland Divisions. By 1978 sketch plans were in train for a two stage extension to the herbarium.

The scientific output of Botany Division during these first fifty years is contained in just over 1000 books, bulletins, and papers, not to mention the very large number of unpublished environmental reports for other Government Departments, local bodies, etc. and the day to day advice given to correspondents, particularly through our

identification service. More detailed accounts of our work can be found in the Annual Reports of the Department, in the Divisional Triennial Reports, beginning 1957-59 and in the monthly Botany Division Newsletter produced by A. D. Thomson and begun in 1974. In the field of plant classification and description the emphasis was first on introduced plants, then on natives, and is now evolving towards a fusion of both. The first Flora in which this fusion will be complete, with native and adventive given equal treatment, will be on the grasses, and this is being written. Thirty years ago the pressure of *ad hoc* work was so great and the staff so small, that the only possibility of writing a Flora was in retirement as a one-man job. Dr Allan attempted this and almost succeeded. At the present time three Floras are being written concurrently, with two authors on the grasses, four authors on the adventive dicotyledons and one author on the lichens. This work is supported by a good library and experimental gardens, and a herbarium of some 300,000 specimens, which is, in effect, a national herbarium and is widely consulted.

Whereas it has been possible to develop a sound base for Flora-writing it has not been possible to do as much work on vegetation as is necessary. Flora-writing was implicit in the work of the Division from the earliest days, but the Division was not created to do survey work as was Geological Survey and Soil Bureau. In the beginning, studies of vegetation were often done in the officer's own time. Early official projects involved types of vegetation not studied by other Departments such as depleted tussock grasslands, weeds, swamps and bogs, and plants of lakes and rivers. Most of these were related to economic problems and received some support. By the same token the growing need for regional stations was partially satisfied, only as a result of economic and political decisions leading to the urgent need for research on vegetation in Nelson-Westland and Otago-Southland. The important Wellington substation arose because of the move to Christchurch, and only the Auckland substation was created as a result of our advocacy to plan for the future, and not as a result of an emergency or a historical accident. With the staff available we have attempted two surveys of more than local importance: a survey of several National Parks and a survey of existing Reserves. But in both cases most officers concerned have been continually diverted to other more immediate tasks as the demand for advice on environmental questions escalates. The work will be finished but far slower than envisaged; and it stretches our staff resources to the limit, particularly as we endeavour to maintain research on vegetation to anticipate future problems. Meanwhile the remnants of unreserved lowland forest remain to be surveyed. Dr Park has devised and tested a procedure for quick surveys by relatively unqualified people, but we can only offer supervision and analysis of results to any other group able to do the field work.

The Palynology Section is also understaffed, and after a decline in

numbers has only been returned to its strength of thirty years ago. The increasing importance of our honey exports and the need for quality control based on pollen content places further pressure on this group.

As we enter our second half-century the chances of improvement in our staffing position seem remote, because of the current policy to reduce staff numbers in Government Departments. We can only continue to emphasise the fundamental contribution made by our native vegetation to the genius of the New Zealand landscape; and stress its special importance in the components of scenery and its vulnerability and fragility. And also continue to emphasise the fundamental position of plants and vegetation in the chain of life, and the dependence of all other living things upon them—not only the utilitarian dependence of animals for food and shelter, but the non-utilitarian influence in the life and well-being of Man himself.

STAFF LIST 1928-1978

(E. J. Godley)

Scientists and Technicians

H. H. Allan	1928-48	T. W. Rawson	1945-75
V. D. Zotov	1928-68	J. G. Gibbs	1947-49
C. E. Woodhead	1931-36	Audrey Cook	1947-54
A. E. W. Reed	1934-35	A. P. Druce	1947-54
I. W. Davey	1936-45		1958-
A. L. Poole	1937-50	J. B. Hair	1947-74
D. Cairns	1938-44	N. T. Moar	1947-
Lucy Moore	1938-71	M. E. Roberts	1948-50
Ruth Mason	1939-74	Philippa Barker	1948-51
I. A. McNeur	1940-41	M. H. Bannister	1948-52
	1947-50	A. H. Amos	1949-50?
	1952-53	Joyce Sansom[1]	1949-50
W. R. Boyce	1940-55	Helen Clark	1949-51
Miriel Sinclair	1940-41	Gertrude Roberts	1949-50
A. J. Healy	1941-46	Margaret Simpson	1950-
	1949-77	H. Penhall	1951-51
H. E. Connor	1941-	C. M. Smith	1951-57
Lai-yung Li	1942-42	C. Kundycki	1951-55
W. F. Harris	1944-55	R. V. Mirams	1952-53
Barbara Harman	1945-46	Rasma Licitis	1954-55
Doris Filmer	1945-48	Margot Ashwin	1954-59
R. Dun	1945-48	E. J. Beuzenberg	1954-
Sheila Boyce	1945-50	A. A. Sutherland	1955-64
B. G. Hamlin	1945-54	Bryony Macmillan	1955-

[1] Goldsmith's Scholar

Judith Harrison	1956-62	A. R. Mitchell	1968-70
B. M. Gilpin	1957-64	A. E. Esler	1969-
Judith Hay	?	Diana Kelly	1969-75
Pauline Harrigan	?	M. K. Reynolds	1969-
E. J. Godley	1958-	P. H. Raven[4]	1969-70
I. A. E. Atkinson	1958-	Elizabeth Rivers	1969-71
F. J. F. Fisher	1958-65	B. P. J. Molloy	1969-
J. E. Herkert	1959-61	G. B. Knight	1970-70
Elizabeth Edgar	1959-	Mary Chapman	1970-74
P. Wardle	1960-	Sandra Astridge	1970-75
A. H. MacRae	1960-66	Linda Stemmer	1970-76
W. R. Sykes	1961-	M. J. Parsons	1971-
R. Melville[2]	1961-62	A. D. Campbell	1971-80
Jane Taylor[3]	1961-63	A. D. Thomson	1971-
G. C. Jackson	1962-62	M. S. McGlone	1972-
I. R. Fryer	1963-65	D. J. Galloway	1972-
	1967-70	Mary Kalin-Arroyo[5]	1973-74
Karina Jansen	1963-63	J. C. E. Hubbard	1973-75
Ann Latter	1963-64	P. N. Johnson	1973-
Frances McNish	1963-64	Dorothy Hancock	1974-74
Jean Clarke	1963-69	S. R. June	1974-78
Ann Quigley	1964-64	Pauline Douglass	1974-
Judith Pawsey	1964-65	Pru Newton	1974-77
B. E. V. Parham	1964-71	D. J. Court	1974-75
Eileen Wilson	1964-65	R. D. Wood[6]	1975-76
W. D. Burke	1964-65	G. N. Park	1975-
Alison Watkins	1964-70	P. J. Garnock-Jones	1975-
Barbara Pearson	1964-74	C. J. Webb	1975-
S. L. Kircher	1965-67	R. N. Patel	1974-
G. C. Kelly	1965-	G. Y. Walls	1975-
J. V. Myers	1965-	Barbara Matthews	1975-
D. R. Given	1965-	P. A. Williams	1975-
Kathy O'Neill	1966-68	R. B. Allen	1975-
E. J. Braybrooke (Miss)	1966-66	Shirley Bowman	1975-77
J. M. Mawson (Mrs)	1967-67	Julie Shand	1975-
D. G. Drury	1967-74	Vivienne Cassie	1975-
H. J. Armstrong	1967-68	W. G. Lee	1976-
Melva Philipson	1967-	Debbie Beetham	1976-
A. W. Purdie	1967-	Kalesi Vakaloloma	1976-77
Diane Smith	1968-	Lynne Scott	1977-

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[2] DSIR Senior Research Fellow.

[3] DSIR National Research Fellow.

[4] Senior Postdoctoral Fellow, National Research Advisory Council.

[5] Visiting Research Fellow.

[6] Visiting Research Fellow.

Library

Ruth Leatham	1949-49	Mollie Blackmore	1960-80
Helen Drummond	1954-55	Robyn Bell	1966-70
Patricia Davie	1955-55	Ann Leask	1970-73
Anne Lucas	1955-56	Sue Griffin	1973-76
Joan Jackson	1956-57	Lynley Gordon	1974-
Ann Somers	1957-59	Brenda Smith	1976-79
Barbara Harris	1959-66		

Botanical Artists

Nancy Adams	1943-59	Victoria Vendetti	1973-74
K. R. West	1959-79	Judith Mulholland	1974-75
Yvonne Orpwood	(P.T.)	Jenny Watson	1975-75
Jenny Anderson	(P.T.)	Gabrielle van Bree	1975-76
Dorenda Britten	(P.T.)	Robyn Conway	1976-
Beverley McCulloch	1969-73		

Office

Patricia Travers	1937-45	L. J. Cooper	1967-78
Agnes Hutson	1948?-54	Vera Gilmour	1971-72
Gwen Roberts		Mona Jones	1972-73
Mollie Cassidy		Shirley Townshend	1972-73
R. J. L. Sheehy*	1954-61	Margaret Richardson	1973-73
Margaret Syddall	1954-59	Gilian Carnielo	1973-74
Marilyn Jackman	1959-62	Ann Olsson	1973-76
V. F. Pennington*	1962-66	Pat Farrington	1974-76
Heather Birch	1962-63	J. A. Coleman*	1975-79
Dorothy Pennington	1963-64	Jill Burton	1976-76
Pamela Knox	1964-65	Rosemary Amer	1976-
Abigail Davidson	1965-72	Helen Greatrex	1977-77
J. Thoms*	1966-75	Lila Williams	1977-

Experimental Gardens

J. Swindlehurst† (Moutoa)	J. L. Dryden (Waiwhetu)	
G. Briggs† (Waihetu)	B. L. Nicholls* (Lincoln)	1956-60
R. R. Briggs (Waiwhetu)	I. C. Brown* (Lincoln)	1958-

E. White, W. J. Fuller, C. Arps, P. E. Page, I. Tiplady, H. J. F. Pratt, W. Broomhall, Jean Clarke, C. H. Fletcher, G. F. Heasley, C. R. Hogan, R. A. J. Marcon, R. W. Smith, K. Barlow, P. Barlow, E. J. Purcell, Dorothy Smith, A. J. Smith, R. Smith, G. F. Neill, K. R. Pengelly, G. W. Manson, A. Taylor, E. V. Watson, J. Keenan, D. Simpson, M. A. Guthrie, Betty Happer, R. J. Dunn, Judith Worthington, W. Carter, R. Mudgway, M. DeGoldi.

* Administration Officer.

† Foreman.

* Officer-in-Charge.

A. J. HEALY

Mr A. J. Healy retired on 3 March, 1977, after working at Botany Division for 33½ years, including 25½ years as Assistant-Director. Arthur Healy was educated at Feilding Agricultural High School and Massey Agricultural College. In the second year of his degree course he was awarded the Bledisloe Prize for the best student of his year; and in long vacation work, as a prerequisite for terms in Sheep Husbandry, he wrote a Sheep Farm report on Pelorus Sound, which included a section on the flora of the district. This led to correspondence and later friendship with the veteran Marlborough botanist J. H. McMahon.

Arthur Healy first came to Botany Division as a casual worker on 19 October, 1940, immediately after his final examinations for B.Ag.Sc. Then, after three months military camp, he was appointed to the temporary staff on 1 April, 1941. In writing to Dr Allan from Massey College he had mentioned that his inclinations were towards ecological work, possibly on vegetation in relation to soil erosion, or possibly on one or another of the more economically important weeds of the country. And it was the latter field which became his life's work and in which he became the acknowledged New Zealand authority—the taxonomy and ecology of our adventive plants.

Mr Healy's first major task was a survey of the introduced and noxious nassella tussock in North Canterbury, and this formed the basis for his M.Ag.Sc. thesis entitled "Ecology and economics of nassella tussock (*N. trichotoma*) in North Canterbury and Marlborough". His Master's degree was taken extra-murally and involved study for papers in the evenings with occasional visits to Palmerston North to discuss progress with Dr Yeates. The degree was conferred in 1944 with Equivalent First Class Honours, and in 1945 there appeared his monograph on nassella tussock (N.Z. DSIR Bulletin No. 91) which is still the authoritative work on the subject. This bulletin gave impetus to the Nassella Tussock Act, 1946, upon which Mr Healy advised, including attendance in Parliament to assist the Minister when the Act was debated. This Act made provision for the control and eradication of the weed, and for the constitution of the North Canterbury and Marlborough Nasella Tussock Boards, on both of which Mr Healy was a foundation member. In 1947-48 he served on a committee which considered noxious weeds and was responsible for drawing up the Noxious Weeds Act of 1950; and later he was a foundation member of the Interdepartmental Committee on Nassella Tussock.

In June, 1946, Mr Healy was appointed to the permanent staff, and in September transferred to the Public Works Department as Soil Conservator, Blenheim. In October 1947 he became Soil Conservator at Head Office responsible for the Waikato. He returned

to DSIR in June, 1948, to work on agricultural publications in the Information Bureau, Head Office, and in January, 1949, returned to Botany Division as Assistant-Director to Mr A. L. Poole.

Between 1942 and 1959 Mr Healy published 11 papers drawing attention to new records of adventive species and extensions of range, and including an account of the weeds of Chatham Islands (with E. A. Madden). From then on the accent of his work shifted towards making available, in a readable and well-illustrated form, the means of identifying and differentiating important adventive plants. Such information was badly needed by the increasing number of people involved in the use of the new selective weed-killers. A series of papers beginning in 1953, and given to annual conferences of the New Zealand Weed and Pest Control Society on such topics as "Identification of Rushes" or "Identification of Thistles", was brought together under the title "Identification of Weeds and Clovers" and published by the Society in 1970. A second revised and enlarged edition of this very successful work appeared in 1976 containing further papers given to the Society; and a third edition is in preparation. An important feature of these papers is that Mr Healy broke new ground by including keys based on vegetative characters and underground parts so that identification was possible the year round and not just in the reproductive phase. In 1969 the Society also published "Standard Common Names for Weeds in New Zealand" and Mr Healy played the major part in preparing the text. A book with B. E. V. Parham on "Common weeds in New Zealand" was published in 1976 and a new edition is in preparation.

Throughout his career Mr Healy was an assiduous collector, but not only of adventive plants. Our lichen collection was enriched by his gatherings of bark and rock lichens and a recent paper on the Graphidaceae and Opegraphaceae (Hayward, *N.Z. Jl. Bot.* 1977) makes important use of many of these. Spiders (harvestmen) were collected for Dr R. R. Forster and provided type material for at least 4 new species e.g. *Rakaia healyi* Forster (*Dominion Museum Records in Entomology*, 1948). Organisms attacking plants were also collected. *Aphis healyi* Cottier, one of our few indigenous aphids, commemorates "Mr A. J. Healy who has collected all the specimens'. Plant galls were also gathered (see Lamb, *Trans. R.S.N.Z.* 1960) and *Aceria healyi* Manson (*Acarologia*, 1970) which causes gall-like pustules on *Myoporum laetum* was "named for Mr A. J. Healy who has collected a great deal of eriophyoid gall material". And fungi were also gathered (e.g. Baker, *Trans. R.S.N.Z.* 1955).

In parallel with his collecting and writing (which also included definitive accounts of the introduced vegetation of New Zealand and of the adventive plants of Canterbury) went the more everyday tasks, all receiving careful atention. A major interest was his Chairmanship of the Library Committee and expansion of our holdings of Floras

and periodicals. And there were always identifications to be made, each reply giving not only names but other useful comments. And added to this were his many administrative tasks as Assistant-Director.

Mr Healy always campaigned against the danger of unwise plant introduction, and devoted much time to commenting on the lists of requested plant imports sent by the Department of Agriculture. And he also devoted much time to studying plant dispersal by human activity, such as the introduction of fruits and seeds on clothing and footwear, or in agricultural produce (e.g. weeds in Australian bulk wheat), or with merchandise, or in retrieved machinery and tenting from the Pacific war theatre. His unrivalled knowledge of adventive plants led to his appointment to the Committee of Enquiry into Noxious Weeds Administration which reported to the Minister in 1973; and this led to further work behind the scenes leading to the Noxious Plants Act of 1978. Because of Mr Healy's unanticipated retirement date, completion of the third volume of "Flora of New Zealand" loomed large in our minds, and in 1974, by mutual agreement, he was freed from distractions of administration as Assistant-Director, to concentrate on this work, which he and Dr Edgar completed by 1977. Of great value in this and future volumes was the index to first records and the literature of adventive plants, which Mr Healy had built up over the years.

In 1978, after his retirement, Mr Healy visited South Africa on a 2 month research fellowship from the Department of Agricultural Technical Services to examine the known infestations of nassella tussock and discuss weed legislation in general. He also delivered the opening address, on the adventive flora of New Zealand, to the annual joint congress of the South African Association of Botanists and the Grassland Society of South Africa. And in 1980 he has been co-opted to the North Canterbury Nassella Tussock Board where, 33 years ago, he was a foundation member, and where he continues to grapple with a problem which had led to his acquaintance with twelve Ministers of Agriculture.

Mr Healy's work was recognised by his election as Honorary Life Member of the N.Z. Association of Inspectors of Noxious Weeds (now Institute of Noxious Plant Officers) in 1968; as Honorary Life Member of the New Zealand Weed and Pest Control Society Inc. in 1972; and as an Associate of Honour of the Royal N.Z. Institute of Horticulture in 1977. I would like to add my personal appreciation of all the work that Arthur Healy has done for New Zealand, and for the Botany Division, and for all the assistance which he gave me as Assistant-Director. His career in the Public Service exemplifies "Botany in the service of Man" and his work still continues. E.J.G.

THE HERBARIUM

(International Code, CHR)

(Herbarium Keeper, Dr D. R. Given)

In 1977 and 1978 15,000 sheets were added to the herbarium annually, bringing the estimated total to 304,000. With the addition of 18 tall steel cabinets to house the expanding collection, considerable reduction of working space was necessary and improved lighting between the cabinets was required.

Particularly large contributions have been made to the herbarium by Mr A. P. Druce of specimens from central and southern North Island and north-west Nelson; Mr J. K. Bartlett from northern North Island; and Mr H. D. Wilson from Stewart Island. Dr G. Brownlie donated his New Zealand herbarium of indigenous and naturalised vascular plants and his ferns of Fiji and New Caledonia comprising about 5000 sheets.

In the Triennial Report 1972-75 it was estimated that 8000 sheets were received with the Canterbury Museum Herbarium in 1975. Already 13,000 specimens have been incorporated and the curating of that collection continues.

Type specimens, including isotypes of primary types held at other institutions, now total 460. We are grateful to those New Zealand taxonomists who have deposited types of recently published taxa, in particular Dr G. Brownlie for ferns of Fiji, and Dr P. J. Brownsey for *Asplenium*.

We are most grateful for the following donations of specimens:

Mr J. K. Bartlett	Northern North Island vascular plants and lichens.
Dr R. E. Beever	Thames district, Little Barrier Island.
Dr J. E. Braggins	*Pteris*.
Dr G. Brownlie	Ferns of Fiji and New Caledonia. His angiosperm herbarium.
Dr P. J. Brownsey	*Asplenium*.
Mr A. M. Buchanan	*Coriaria* from Mexico. Kenya, Tasmania, Seychelles.
Dr J. Child	Tongan lichens and ferns.
Mr A. Dakin	Lichens.
Dr & Mrs O. Degener	Hawaii.
Dr A. T. Dobson	Adventives and swamp plants. Tasmania.
Dr J. S. Dugdale	Cook Islands.
Mrs F. C. Duguid	Levin district.
Mr L. Esler	Dunedin district.
Mr A. Frost	Mosses from Seaward Kaikoura Range and Antarctica.
Mr P. Gardner	Cook Islands.
Mr A. M. Gray	*Apteropteris* from Tasmania.

Mr R. Gray	Kakapo food study, Maud Island, Milford Sound, Stewart Island.
Mr A. J. Healy	South Africa.
Mr A. M. Huber	Queensland.
Dr B. R. Jackes	*Acrotriche.*
Dr J. Lewinsky	New Zealand bryophytes.
Mrs B. McCulloch	Marlborough Sounds.
Mr T. McIntosh	Craigieburn Range.
Mr M. J. McLennan	Lake Hauroko.
Mr G. McSweeney	Murchison Mountains.
Dr C. Marchant	Tongan ferns.
Miss R. Mason	Tasmania.
Mr L. J. Metcalf	Thompson Sound.
Mr C. D. Meurk	Campbell Island.
Dr D. M. Moore	Tierra del Fuego.
Dr L. B. Moore	Some of the plants used to illustrate "The Oxford Book of New Zealand Plants" by L. B. Moore and J. B. Irwin.
Dr M. J. Parsons	His vascular plant herbarium.
Mrs J. A. Petterson	Blue Mountains, New South Wales. *Wahlenbergia.*
Dr W. R. Philipson	*Araliaceae.*
Mrs F. Powell	Herbarium of R. Powell, Wallacetown.
Mr G. B. Rawlings	North Auckland.
Dr D. R. Stoddart	Cook Islands.
Dr J. C. Tothill	Queensland.
Dr N. M. Wace	Horn Island, Tierra del Fuego.
Dr A. Whistler	Cook Islands.
Dr E. Williams	*Nicotiana cavicola.*
Mr H. D. Wilson	Tasmania. Stewart Island.
Dr K. Wodzicki	Tokelau Island.
Canterbury Botanical Society	Kirkliston Range.
Botany Department, University of Canterbury	W. H. Lintott Pitcairn Island collection.
Forest Research Institute N.Z. Forest Service	New Hebrides.
Grasslands Division, DSIR, Palmerston North	*Bromus, Lotus.*
National Museum, Wellington	Ferns of Philippine Islands and New Caledonia.
Wanganui Museum Botanical Group	Wanganui district.

Exchange of duplicate specimens was continued with 55 herbaria and some of the larger consignments were received from:

University of Aarhus, Denmark.
State Herbarium, Adelaide.
Auckland Institute and Museum.
Queensland Herbarium, Brisbane.
National Museum of Canada, Ottawa.
Herbarium Australiense, CSIRO, Canberra.
Universidad Nacional de Nordeste, Corrientes, Argentina.
Systematisch-Geobotanisches Institute, Göttingen.
Royal Botanic Gardens, Kew.
Polish Academy of Sciences, Krakow.
Rijksherbarium, Leiden.
University of Liège, Belgium.
Lakehead University, Ontario.
University of Massachusetts.
Michigan Technological University.
Missouri Botanical Garden.
National Herbarium, New South Wales.
Botanic Gardens, Singapore.
University of Tokyo.

An average of 55 loans to and from the herbarium have been handled annually, more than half of them with foreign institutions each year. Loans of six type specimens overseas required permission for temporary export from the Secretary of Internal Affairs in accordance with the Antiquities Act 1975.

Fifty visitors worked in the herbarium, and displays of specimens were shown to visiting groups.

For several years contact has been maintained with herbaria engaged in the use of data retrieval techniques and storage, generally by computer (EDP). A preliminary pilot scheme was started at the end of 1975 and by the beginning of 1978 several thousand sheets of Gymnospermae and Loranthaceae (Mistletoes) had been data banked, using 80-column cards. Catalogues have been produced with specimens arranged according to the following pre-determined fields: collector and date, geographic distribution from north to south, nearest major locality, and genus and species. This will allow greater use of herbarium specimens in conservation and ecological projects, for phytogeographic studies and in the preparation of checklists and collector itineraries. A semi-intelligent terminal and printer is on order and will be used in conjunction with the DSIR computer network. A final decision has not been made on the exact package to be used for storage and retrieval but it is likely to be SELGEM which was developed by the Smithsonian Institution and is extensively used for this sort of purpose overseas. Entomology Division, DSIR,

has been assessing SELGEM, using the National Insect Collection at Auckland.

Space is at a premium in the herbarium and will remain a problem until building extensions occur. Preliminary plans are being drawn up for a two stage extension. This will facilitate preparation and study of specimens and will allow holdings to eventually increase by a factor of about three.

Throughout the herbarium, work on naturalised plants for volumes in the Flora of New Zealand series, is reflected in increased holdings of specimens of plants naturalised in New Zealand. Substantial increases in Compositae, Rosaceae, Umbelliferae and the Monocotyledons will probably be matched by similar increases in other taxonomic groups as they are revised. Authentic overseas specimens of numerous weedy genera are being acquired by exchange. The appearance of many new names and the disappearance of other, sometimes long familiar, genera and species means considerable relabelling and rearrangement of some sections of the herbarium. A Stripdex Index has been installed to help users locate genera and families quickly.

The last three years has seen a large increase in the number of Pacific Island species in the herbarium. These have been acquired not only by exchange, but also by members of Botany Division staff and others collecting specifically for this herbarium. Holdings of Tongan material may now be the largest in the world, and those of the Cook Islands are substantially complete. Specimens from the South and Southwest Pacific region are important not only in the study of Pacific Island floras but also for taxonomists working on New Zealand plant groups with tropical affinities.

Pteridophytes (Dr D. R. Given)

Incorporation of the extensive collections previously held by Canterbury Museum and the fern herbarium of Dr G. Brownlie has substantially increased holdings of pteridophytes. The Canterbury Museum herbarium included the primary pteridophyte collections of H. Carse from Northland, several hundred sheets collected by Selim Berger and others in Malesia, and duplicates of many specimens in the Cheeseman Herbarium at AK. The herbarium of Dr Brownlie includes most of the types of new taxa described in his fern flora of Fiji and his collections from Fiji and New Caledonia. Other substantial contributions to the pteridophyte herbarium include collections by J. K. Bartlett from the northern part of the North Island; subantarctic collections made by D. R. Given during the 1975-76 expedition to Campbell Island; and collections from the Fiji and Tonga island groups by P. Garnock-Jones and W. R. Sykes.

This section of the herbarium is being rearranged according to the system of Crabbe, Jermy and Mickel (*Fern Gazette* 11: 141-62, 1975). Genera are arranged in a numbered system and their position does

not depend on the particular family scheme adopted. At the family level we have departed from Crabbe *et al.* in recognising segregate families of the Cyatheaceae, Lindsaeaceae, Athyriaceae, Aspidiaceae, Lomariopsidaceae, Oleandraceae and of Marsileaceae. Although the system differs considerably from arrangements generally used in New Zealand floras, it probably represents more accurately the relationships between various genera and is being adopted as the herbarium system at New York Botanic Gardens and British Museum.

Preliminary mapping of the Pteridophyta was completed by Mrs D. L. Bourgeois at the end of 1978. New accessions are being mapped before incorporation in the herbarium. This has proved a useful exercise in pointing to regions which are under-collected in New Zealand. The intensive collecting of pteridophytes over the past eight years now means that many distribution patterns are sufficiently well known for generalised patterns to be defined and some preliminary phytogeographic conclusions to be made.

Bryophytes (Miss B. H. Macmillan)

Exchange has continued with British Antarctic Survey at the Institute of Terrestial Ecology, Penicuik, Scotland; University of Alberta; Museo Argentino de Ciencias Naturales, Buenos Aires; Botanical Museum, Copenhagen; Dr W. J. Hoe, University of Hawaii; and Missouri Botanical Garden. The foreign collections (excluding the T. W. N. Beckett Herbarium) are being arranged in systematic order after Crosby, M. R. and Magill, R. E. "A Dictionary of Mossess", Missouri Botanical Garden 1978. Loans of New Zealand and foreign material of 14 genera have been sent to foreign institutions.

Moss and liverwort collections in the herbarium from the West Coast Beech Project area were catalogued and a short review of known work in the area was published in *Beech Research News No. 6,* 25, 1978. The floras of two experimental catchments in beech forest in Nelson were collected. Of a total of 168 species, 42% were common to both sites. An account of the flora and ecology of bryophytes at Bankside Reserve was contributed to the "Biological Reserves of New Zealand" (*N.Z. Journal of Botany 14:* 131, 1976).

Stimulating visits by Dr D. A. Ratkowsky, CSIRO, Tasmania, and Dr M. Crosby, Missouri Botanical Garden, were enjoyed.

Lichens (Dr D. J. Galloway)

The lichen collections have been substantially arranged in alphabetical order by genus, incorporating both foreign and New Zealand material. Packets are laid flat in genus or species folders which are colour coded for region or origin, as in the vascular plant herbarium. The many type specimens, of Zahlbruckner and William Martin, are place in red-bordered covers within the species.

The extensive herbarium of William Martin bequeathed to us in 1975 has been incorporated. The T. W. N. Beckett lichens

originally identified by J. Stirton, and received from the Canterbury Museum in 1975 are kept intact.

Present taxonomic work in the group has resulted in a renewed interest among New Zealand collectors and ecologists so that a steady flow of specimens has been received for identification during the last three years. We are most grateful to the many people who have contributed specimens and information towards the revision of the lichen flora.

Algae (Dr M. J. Parsons)

With the part time help of Mrs Mary Stolp, the general curation of the older collections of the algal herbarium proceeds. About half the boxes of the red algae (25% of the whole algal herbarium) have been sorted, mounted and labelled. About 80% of these specimens have never been firmly identified. Proper determinations will be done as time permits or as each genus or species is studied in detail for some other purpose. A box of Halopteris specimens and papers set aside some 30 years ago, when Dr L. B. Moore was studying the genus, has now been sorted and the specimens, including some type fragments, are available for use.

General collections from south eastern coast of the South Island and Kaikoura have been processed. Some of the larger brown seaweeds have been glycerised whole so that all features of these plants will be represented in the herbarium. From most of these general collections representative portions of the plants, especially if fertile, are kept in liquid collection and are available for further study along with the dried herbarium sheets. Representative microscope slides made up from the liquid collections or from dried material are now kept as an important part of the herbarium.

The Dr Don Horning collections, of about 1500 numbers, from the Snares Islands have nearly all been processed, basic labels have been typed and the identifications are being systematically worked through.

Over the years there have been several collections from off-shore islands deposited in the Herbarium, but these were stored and unavailable for study. Curation of these collections continues, and lists of algae are produced as each collection is studied. The I. and M. Ritchie collection from the Chatham Islands, the P. Johnson collection from the Solanders, the C. Meurk collection from Campbell Island, and the D. S. Horning Jr collections from the Snares Islands and Antipodes Islands are included here. The Cape Expedition collections made during the 1940s are also being identified and laid into the herbarium.

In December 1978, the M. J. Parsons algal herbarium was donated and during the summer, student help incorporated it in CHR. This herbarium of over 2000 numbers, many with duplicates, has a very strong southern Australian content, especially in the Dasyaceae and Lophothalieae of the Rhodomelaceae. Duplicates of this material have

been distributed to WELT, NFLD, G. Kraft at MELU and W. J. Woelkerling at LTB. Many of the specimens have portions preserved in liquid and there are about 1000 microscope slides including a second set of those used for the morphological study of the Dasyaceae and Lophothalieae of southern Australia (*Aust. J. Bot. 23 (4)* : 549-713, 1975).

Most of the algal collections from the herbarium of the Canterbury Museum have been mounted and numbered. These include: 196 algae collected by Dr Sven Berggren of Lund, Sweden, during his 1874-75 journey through New Zealand, three from Hawaii, four from Golden Gate, California and two from Sweden also collected by Berggren; thirty-three sheets of algae obtained by W. R. B. Oliver from the Kermadec Islands deposited by R. M. Laing; twenty-seven miscellaneous algae including seventeen sheets of non-foliose species of *Gigartina* also deposited by R. M. Laing. One bound album and five albums of loose sheets of British seaweeds have been listed. Although only about half these specimens have any collection data with them, several are labelled "S 1793" or 'S 1794". It has been suggested that these specimens might belong to the lost Stackhouse herbarium and a complete list, with xerox copies illustrating the handwriting on the specimens, will be sent to the present writers of the British macroalgal flora at the British Museum (Natural History) to see if we can obtain any further information.

The early collections obtained from the Canterbury Museum herbarium have inspired the making of an index to early collectors of algae, and the localities they visited. It is hoped that this index, which will include samples of handwriting of the collectors and the researchers who worked on the specimens, will lead to a series of notes on New Zealand phycological history.

Algal exsiccatae received since the last triennial report include: R. G. Hooper and G. R. South, Memorial University of Newfoundland, Canada "Algae Terrae Novae" set VIII nos. 151-170, set IX nos. 171-200; also from this herbarium the Josephine E. Tilden *et al.* South Pacific Plants, second series 1934-35, Algae, Issues I-IV containing 494 numbers from New Zealand and Australia; Professor H. B. S. Womersley, Adelaide University, South Australia, Marine Algae of Southern Australia nos. 142-187c; W. J. Woelkerling, Exsiccatae from New England, U.S.A., sets 1-3, 70 numbers (ex M. J. Parson's herb.). C. Hay collections from Vancouver Island (Canada), Nova Scotia, and Newfoundland, 55 numbers; W. F. Prud'homme van Reine, Rijksherbarium, Leiden, Algae Zeelandicae, Series 1-2, 61 numbers.

The Charophyte collections used by Professor Richard Wood and Miss Ruth Mason for the monograph on the New Zealand species have been fully annotated by Miss Mason to match comments in the manuscript. These collections include Professor Wood's personal

herbarium (now at New York Botanical Garden) and specimens on loan from BM, MEL, LD, the New Zealand herbaria, and the comprehensive collection here at Botany Division. A microscope slide collection made by Professor Wood during his studies is held in the herbarium.

THE LIBRARY

(Mrs M. E. Blackmore)

Grants from the Trustees of the National Library of New Zealand made possible the purchase of two valuable accessions:

(1) A copy of the "Jodrell Card Index of Anatomical Literature" held at Kew. The index of over fifty thousand cards is arranged in two main parts—by families of angiosperms and by subjects.

(2) Schimper, W. Ph. 'Bryologica Europaea". An important addition to the collection of bryophyte literature transferred with the Beckett Herbarium from the Canterbury Museum.

The library is pleased to accept archival material pertaining to New Zealand botany and is grateful for the large number of notebooks and papers received from the estates of K. W. Allison, W. Martin, W. B. Brockie and V. D. Zotov.

Our microfiche collection is steadily growing as more early botanical works are reproduced in this form. The reader/printer bought in 1978 has made the collection more accessible to staff and other borrowers.

New additions to the holdings of world floras include the floras of Bangladesh, Cyprus, Libya, Eastern Himalaya, Micronesia, Canada, New Caledonia, Swaziland, Jebel Marra, Sudan, Okinawa and the Southern Ryukyu Islands, and Papua New Guinea.

The following is a selection of early literature added to the library:

Aublet, J. B. C. F. Histoire des Plantes de la Guiane Francaise. 4 v. 1775. Microfiche.

Adansonia 1-12 (1860-79) Microfiche.

Baudin, N. T. The Journal of Post Captain N. Baudin 1800-03. Translation 1974.

Bennet, J. J. and Brown, R. Plantae Javanicae Rariores. 1838-52. Microfiche.

Hooker, W. J. Musci Exotica. 1818-20. Microfiche.

Hudson, W. Flora Anglica. 1762. Microfiche.

Journal of Botany, British and Foreign 1-63 (1863-1925). Microfiche.

Miller, P. Gardeners Dictionary. 8th ed. 1768. Microfiche.

Schumann, K. M. and Lauterbach, K. Die Flora der Deutschen Schutzgebiete in der Sudsee und Nachtrage. 1901-05. Facsimile Reprint 1976.

Trinius, C. B. and Ruprecht, F. J. Gramina Agrostidea. 1842. Microfiche.

We are most grateful for the following donations:

Presented by Mrs F. Reilly.
Thompson's "Gardeners Assistant". 1877.
The Floricultural Cabinet and Florists Magazine. V. 2. 1834.

Presented by Dr W. M. Hamilton.
Langdale-Brown, I. The Vegetation of Uganda and its bearing on Land-use. 1964.

Presented by Mr J. Holloway.
Vegetationsbilder Volume 22, Parts 5-6.

Presented by Miss R. Mason.
Burbank, Luther. The harvest of the years. 1927.

Presented by Dr A. D. Thomson.
Hight, James. A short history of the Canterbury College. 1927.

Presented by Professor Harold C. Bold.
Phycological Studies 1-4. Reprint. 1975.

Presented by Mr S. Challenger.
Berkeley, M. J. Introduction to Cryptogamic Botany. 1857.

Presented by Mrs Avice Hill.
Murphy, Michael. Handbook of Gardening for New Zealand. [1895].

Presented by Dr D. J. Galloway.
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THE EXPERIMENTAL GARDENS

(Mr I. C. Brown)

The Experimental Gardens consists of 2.0 ha in Headquarters Block and 7.25 ha in East Block. Headquarters Block is divided into 16—1000 m^2 plots where irrigation is available from a 15.24 cm well and oscillating spraylines; East Block also has irrigation through a grid system of underground pipes fed from a 250,000 gallon polythene lined reservoir.

Propagation facilities include two 5.5×9.0 m glasshouses attached to a potting shed, (these glasshouses were recently rebuilt after severe storm damage), four smaller isolation glasshouses, three 5.5×9 m lath shadehouses with PVC roofing and overhead misting, three 7×2.4 m cold frames (the old wooden tops and lights of the cold frames have been replaced with low maintenance aluminium). Supplementary lighting is available in two of the glasshouses, a small mist propagation unit is also available. The Gardens plant records are kept in a fire-proofed cabinet in an office in the potting shed.

Field equipment includes two 35 h.p. and two 12 h.p. tractors. One of the larger tractors is fitted with a portable generator to power

electric trimmers used for hedge cutting. The smaller tractors are used for lawnmowing on Headquarters Block while East Block grassed areas is mown with a larger tractor mounted rotor cut mower.

Field plantings include indigenous species of *Festuca, Poa, Chionochloa, Sophora, Aristotelia, Fuchsia, Coprosma, Carmichaelia, Phormium* and *Hebe*. Extensive *Cortaderia* plantings include both indigenous and introduced species and hybrids and there are also collections of adventive species of *Aster* and *Salix*.

Plants grown in pots for scientific purposes include a collection of native ferns and conifers, *Astelia, Collospermum, Hebe, Parahebe, Uncinia, Carex, Celmisia, Epilobium, Leucogenes, Ranunculus, Pachystegia, Rubus,* orchids and grasses.

A collection of 60 noxious weeds grown in 30 ×30 cm plant tubs is maintained for use at agricultural shows and field days and for weed identification talks to interested groups.

BOTANICAL ILLUSTRATIONS

(Mr K. R. West)

In early 1976 DSIR published bulletin 216—The Genus *Epilobium* in Australasia: a Systematic and Evolutionary Study by Peter H. Raven and Tamra Engelhorn Raven. I had illustrated the book, seen it through the press and also made contributions to a further refining of the concepts of several of the species. Following this work I spent six months in the United States illustrating North American Epilobia as part of a study of the Onagraceae headed by Dr Raven. During a short stay in 1978 plates of the remaining American Epilobia, but for one elusive species, were completed.

Apart from general requirements of staff for illustrations and working on *Epilobium* as outlined above, two other major undertakings were completed during the period under review: detailed pencil illustrations were prepared for Dr P. Wardle's "Plants and Landscape in Westland National Park", and a series of paintings were done in acrylics of florets of the grass genus *Rytidosperma* for Dr E. Edgar and Dr H. E. Connor. Unfavourable economic conditions made it impossible to present the drawings for the Westland book as originally intended with colour added, and also prevented the publication of *Rytidosperma* paintings in colour.

Miss van Bree resigned in June, 1976, after assisting me for one year. For the remainder of that period I have been very ably assisted by Miss Robyn Conway who has prepared diagrams, maps and drawings for a large number of papers and begun work on Volume 4 of "Flora of New Zealand".

During 1979 I resigned to work under contract to the British Museum (Natural History) and Missouri Botanical Garden on a

sequence of paintings of North American plants in natural settings. I left with some regret and also much gratitude for a disciplined apprenticeship of twenty good years with Botany Division.

GENERAL ADVISORY AND SERVICING WORK

(Compiled by Dr B. P. J. Molloy)

Advisory work for various clients continues to increase, especially in the field of nature conservation, as mentioned elsewhere in this report. However, a major share of the service Botany Division provides concerns plant identification. The scope and nature of this service and the broad range of clients are demonstrated in the accompanying table.

Both headquarters and substation staff devote a large amount of their time (up to 25%) to this work, and as many as 1000 specimens of native and adventive plants are identified each year at most centres. In addition, hundreds more are examined each year by specialists in certain groups or covering certain fields, as indicated in the table.

The range and depth of enquiries about a particular plant or specimen can vary considerably. Seed identification, for example, is requested for forensic purposes; to establish impurities in crop, pasture, lawn, vegetable and flower seed, and in wool and packaged food; to help determine the diet of animals through the analyses of stomach contents and faecal pellets; and to assist archaeologists. The depth of enquiries about weeds and cultivated plants is equally great.

While the demand for advice appears to remain at a constant level in some fields, it is increasing in others. For example, there is a growing demand for lists of native plants for different areas, and information on their conservation status and management. Another example is the increasing amount of advice being sought on the identification and protection of plants, especially trees, and the evaluation and culture of plants for reserve enrichment and for landscape enhancement.

Coupled with this growth in the scope of advisory work is an enlarging clientele, both in New Zealand and abroad. The following list places on record most of our current clients in New Zealand:

Farm advisory, Research, Horticulture, Plant Health and Diagnostic Divisions of the Ministry of Agriculture and Fisheries.

Department of Lands and Survey.

New Zealand Forest Service.

Wildlife Service, Department of Internal Affairs.

New Zealand Electricity Department.

Ministry of Works and Development.

Health Department.

Police Department.

Housing Corporation.

Accident Compensation Commission.

Universities, schools, and colleges.

Plant Diseases, Applied Biochemistry, Grasslands, Crop Research, Botany, Ecology, Chemistry divisions, and the Soil Bureau and Geological Survey of DSIR.

Various nature conservation groups and organisations.

City, borough, and county councils.

Catchment Boards and allied authorities.

Noxious plant authorities.

New Zealand Historic Places Trust.

The Queen Elizabeth II Trust.

Commercial and municipal nurseries.

Botanic and private gardens.

Museums and allied institutes.

New Zealand Wool Board.

Tussock Grassland and Mountain Lands Institute.

Park and reserves boards.

Commercial firms and consultants.

Hospitals, medical schools, laboratories, doctors.

Botanical and horticultural societies, trusts and related organisations.

Private individuals.

Since the last triennial report there has also been a noticeable growth in the number of requests and invitations for headquarters and substation staff to review and referee publications, to give talks and lectures, to prepare displays of plants, to lead or participate in field tours, training courses, conferences, seminars and workshops, and to supervise and examine students up to and including Ph.D. level.

Native and adventive dicotyledons Taxonomy section and substations	Identification surveys, collecting specimens supplying live plants	Government departments, local authorities, universities, schools, commercial firms, park boards
Native and adventive monocotyledons Taxonomy section and substations	displays, illustrations, talks, lectures, species lists	organisations, societies, advisory committees, private individuals.
Poisonous, narcotic and noxious plants Headquarters and substations	Identifications, surveys displays, talks, court work	Government departments, local bodies, private individuals.
Tree and flora protection/planting Headquarters and substations	Identification, surveys evaluation	Local bodies, government departments, organisations.
Cultivated plants General—Mr W. R. Sykes Rhododendron—Dr M. N. Philipson	Identification, evaluation, culture propagation	Local bodies, nurseries, societies, government departments, private individuals.
Ferns, mosses, liverworts, lichens Dr D. R. Given, Miss B. H. Macmillan Dr D. J. Galloway	Identification	Universities, DSIR divisions N.Z. Forest Service, private individuals.
Algae Marine—Dr M. J. Parsons Freshwater—Dr U. V. Cassie	Identification Evaluation	Government departments, universities, regional water boards, laboratories.
Anatomy Fossil wood—Mr R. N. Patel Fossil charcoal—Dr B. P. J. Molloy	Identification Evaluation	DSIR divisions, universities archaeologists, private individuals.
Seed Mrs M. J. A. Bulfin and substations	Identification collecting, supply germination	Government departments, local bodies, universities, archaeologists, private individuals, organisations.
Pollen Dr N. T. Moar, Mr M. S. McGlone	Identification evaluation	DSIR divisions, universities, government departments.
Cytology Mr E. J. Beuzenberg	Chromosome counts ideograms	DSIR divisions, universities.
Electron microscopy, microtechniques Dr N. T. Moar, Mr V. J. Myers, Mr M. K. Reynolds, Mr E. J. Beuzenberg	Identification evaluation	DSIR divisions.
Latin diagnoses Dr E. Edgar	Writing/checking descriptions	DSIR divisions, universities.

TAXONOMY

(Dr H. E. Connor)

Joseph Dalton Hooker in Appendix II of Flora Novae-Zelandiae (1855) under the heading "Catalogue of European and other plants introduced into and now naturalized in New Zealand" wrote that ". . . the subject . . . had not occupied the attention of any colonial botanists, . . .". During this last triennium the subject of naturalized plants has occupied the attention of six members of Taxonomy Section who are devoting their efforts towards the production of three further volumes in the Flora of New Zealand series.

"Adventive Cyperaceous, Petalous and Spathaceous Monocotyledons", Volume III of the Flora of New Zealand series, written by A. J. Healy and Elizabeth Edgar, is now being printed. This is the first of the volumes dealing with naturalized plants and will be the first complete account of one group since H. H. Allan's "A Handbook of the Naturalized Flora of New Zealand" (1940), a book that covered both dicotyledonous and monocotyledonous plants. Two books in recent years—"Common Weeds in New Zealand: an illustrated guide to their identification" by B. E. V. Parham and A. J. Healy (1976) discussing 135 of the commonest of weedy plants, both monocotyledonous and dicotyledonous, and "Identification of Weeds and Clovers" (2nd revised edition 1976) by A. J. Healy—catered well in different ways for many naturalized plants but never for any higher taxonomic group as a whole.

"Adventive Cyperaceous, Petalous and Spathaceous Monocotyledons" will also contain novel features for a volume in the Flora of New Zealand series; for those eight genera with both native and introduced species viz *Carex* (73 native, 22 naturalized), *Cordyline, Centrolepis, Cyperus, Juncus* (16 native, 31 naturalized), *Luzula, Potamogeton* and *Scirpus*, the keys will contain both naturalized and native species, and because full details of the native species are in Vol. II abbreviated descriptions only will be presented.

This principle is being carried into the floras in preparation. There is no grass Flora for this country to replace the account in Cheeseman's "Manual of the New Zealand Flora" (1925). H. H. Allan's "An Introduction to the Grasses of New Zealand" (1936) attended in part to both native and naturalized grasses, but it was what he intended it to be—introductory only. Progress towards a volume on the grasses in New Zealand is discussed below, but it is not nearly as advanced as that on dicotyledonous plants, where about three quarters of an estimated 1200 species have been considered. This, too, is discussed below.

Yet another kind of flora is W. R. Sykes' "Kermadec Islands Flora" (1977); this provides comments on the behaviour of all taxa in the islands rather than offering floral descriptions of the plants there. It

is a companion volume to Flora of New Zealand Volumes I and II, but broader in its content than both. "The Poisonous Plants in New Zealand" (H. E. Connor 1977), similarly is a companion volume in the Flora series, but deals specifically with one aspect only of the flora.

Finally, in an effort to indicate, well in advance of publication of the complete naturalized dicotyledonous flora, those plants known to be naturalized here, or known to occur sporadically, a series of "Checklists" is being published (C. J. Webb 1978, W. R. Sykes 1978). These report the name, its first record for New Zealand, and its known distribution; only the description of the taxon is lacking, but because these plants are aliens here their descriptions can be found in extra-territorial floras.

Flora of New Zealand: Naturalized Dicotyledons

1. Labiatae, Boraginaceae etc. (Mr W. R. Sykes)

A draft of 40 families has been prepared, with 300 species being described. The six largest families covered, with the number of species described, are Labiatae 49, Scrophulariaceae 43, Solanaceae 43, Boraginaceae 21, Amaranthaceae 15, and Ericaceae 13. On the other hand, 14 families are represented by a single adventive member. Many of the species described were originally introduced for cultivation but have since escaped and become naturalized to a greater or lesser degree.

Echium: The genus *Echium* in the Boraginaceae provides a good example of species obviously introduced for cultivation, although the common viper's bugloss *E. vulgare* L. may have come to New Zealand accidentally. Today it is widespread in both main islands but is far more abundant in drier inland parts of South Island. It mainly grows on roadsides, shingle banks and similar disturbed sites and the blue haze of viper's bugloss is a characteristic part of the scene in early summer. Although it has been scheduled as a noxious weed it has the beneficial effects of providing some grazing for stock, and helps to check soil erosion because it is a pioneer species on loose, recently disturbed ground; it is of value to the apiarist as a honey plant.

Three other species of this mainly Mediterranean and Macaronesian genus are wild in New Zealand. *Echium plantagineum* L., sometimes known in New Zealand by one of its common Australian names, Paterson's curse, is closely related to *E. vulgare*. However, it is much less abundant here and mostly grows in North Island, especially in the warmer lowland areas. The other two species are long-lived Macaronesian species. *E. candicans* L.f., pride of Madeira, is a spectacular feature of the cliffs of the Port Hills, Christchurch in spring and summer and to a lesser extent its large purple or blue spikes create a similar picture on steep slopes on the Otago Peninsula,

Nelson, Napier and a few other places. Finally, the unusual Canary Island echium is wild on cliffs at Timaru and Bluff in South Island and has recently been reported from Stewart Island. It is a large monocarpic plant whose tremendous pale blue spikes of five metres or so grow from a basal rosette of leaves in about three months. The Canary Island echium is now a very restricted and rare plant in its homeland.

2. Compositae (Dr D. R. Given)

A preliminary account of all Composite genera except *Aster*, *Hieracium* and *Gnaphalium* has been completed. Approximately eighty-eight genera are involved, the exact number being a little uncertain, depending on the attitude taken to some of the more difficult tribes such as Inuleae and Anthemideae. Some familiar names will have to be rejected, notably in *Hieracium*, parts of the Inuleae, and in *Centaurea*.

Some species are not recorded yet in our literature. Of these, one of the most spectacular recent arrivals has been coltsfoot, *Tussilago farfara*, which has spread extensively through the upper Waimakariri basin and the Otira area within 15 years of its first reported sighting. Efforts are being made by Local Authorities to identify sites and systematically eradicate it, especially within Arthurs Pass National Park. Another recent immigrant is *Baccharis halimifolia* which was planted near Christchurch as an amenity shrub in the 1940s, but by the 1960s had started to spread rapidly onto adjacent rocky sites. It has been almost completely eliminated and must be regarded as having one of the briefer periods of naturalization of any New Zealand weed.

Thistles are of economic significance and studies of genera such as *Cirsium, Silybum* and *Carduus* are of interest to agriculturalists. One particular problem concerns possible hybridisation between *Carduus nutans*, nodding thistle, and *C. acanthoides*. This has been reported in Canada and Australia and may be responsible for considerable nodding thistle variation in areas such as Bay of Plenty. Nodding thistle is a conspicuous and striking plant; to some casual visitors many parts of rural South Canterbury are made more attractive by the flowering of this weed although this sentiment is not shared by farmers and noxious plant officers.

3. Rosaceae (Dr D. R. Given)

Although twenty-two genera and over sixty species of rosaceous plants are naturalized in New Zealand, less than half are significant weeds in any part of the country and a relative handful are widespread. Nevertheless, those which are, make up for the remainder by their tenacity and successful weediness. In this handful must be numbered species of *Rosa, Rubus,* and *Potentilla*.

Particular attention has been paid to *Rubus*. The traditional

aggregate *R. fruticosus*, blackberry, can be broken up into several clearcut component species, each with its own distinctive distribution pattern and morphology. Generally within any one area only two or three species of blackberry will be present, and it seems likely that when New Zealand was settled each group of immigrants brought in their own particular kinds of blackberries. Some common forms have yet to be identified positively to species. For example, a single species is dominant (and often rampant) around Dunedin, but it is not yet possible to give it an exact species name. The importance of applying correct names to various components of the *fruticosus* aggregate is seen in the resurgence of interest in blackberry for its fruit. Taste, sugar content, time of maturation and colour vary considerably so that for small fruit picking or wine making it may be vital to know exactly what species are available in the local district.

The genus *Rosa* has been documented in part by Dr B. P. J. Molloy and his data are being used to fill in gaps in knowledge of the dog and briar roses. In the far north of New Zealand, rambling roses, many probably dating back to the early days of settlement, are frequent and have spread along hedge-rows. These are not economic pests but are conspicuous members of the weed flora; as well they provide a source of interesting cultivars. The genus, in fact, demonstrates just how long plants can persist on sites of former settlement, and how difficult it can be to name formerly cultivated taxa which have long been forgotten.

4. Cruciferae (Dr P. J. Garnock-Jones)

Springtime beside country roads in Canterbury and other parts of South Island is ushered in by dazzling yellow drifts of flowers of wild turnip (*Brassica rapa* ssp. *sylvestris*). In North Island its place on roadsides is often taken by wild radish (*Raphanus raphanistrum*), with white and pale yellow flowers. These two conspicuous species are both members of the *Cruciferae* (Brassicaceae), one of the large families of the New Zealand flora with 75 introduced and about 35 native species. The family includes many weedy species which have apparently become adapted, during the last few thousand years, to an association with agricultural man.

The native species are not well known taxonomically and they show a high level of endemism. All native species of Cruciferae are endemic to New Zealand except *Rorippa gigantea, R. palustris* and several species of *Cardamine*. At the generic level, *Ischnocarpus, Notothlaspi* and *Pachycladon* are endemic, as is an undescribed plant from Fiordland which probably represents a new monotypic genus. The largest genera are *Lepidium* (13 introduced, 9 native), *Cardamine* (3 introduced, perhaps 20 native) and *Brassica* (8 introduced).

An account of the New Zealand species of *Rorippa* was published (*N.Z. Journal of Botany 16:* 119-122). *R. stylosa* was found to be an

illegitimate name for the native New Zealand species; it was replaced by the new combination *R. gigantea*. *R. palustris* has previously been misidentified as *R. islandica*.

Rorippa gigantea, not often collected on the New Zealand mainland, has been found in North Taranaki by Mr A. P. Druce, and is now in cultivation at Lincoln. *R. gigantea* has been successfully crossed with *R. sarmentosa* from Tonga, and the hybrid has a low level of fertility. Investigations into the generic relationships of this Australasian and Pacific group of species, named *Nasturtium* sect. *Ceriosperma* by Schulz, have begun.

A preliminary draft of the Cruciferae for Flora of New Zealand is complete, along with several related small families. A checklist dealing with the naturalized species of these families is awaiting publication; it includes 13 species not previously recorded from New Zealand.

5. Papilionaceae (Dr C. J. Webb)

New Zealand's agriculturally-based economy is dependent upon legumes. But many cultivated pasture legumes also occur as weeds, for example, white clover is a garden weed throughout New Zealand. In addition, there are many other naturalized legumes—a total of about 100 species. This includes important genera such as the clovers (*Trifolium*, 24 naturalized species) and medicks (*Medicago*, 7 species). Many of these wild species are problems for agriculture, ranging from the small suckling clover (*Trifolium dubium*) which occurs as a seed impurity in white clover, to the tree, *Robinia pseudacacia* which may be poisonous to stock. Other leguminous weeds such as gorse, *Ulex europaeus*, and broom, *Cytisus scoparius*, are a conspicuous part of lowland vegetation in many areas of New Zealand.

A draft of all naturalized legumes has been completed for the volume of the flora on naturalized dicotyledons.

6. Umbelliferae (Dr C. J. Webb)

Although there are some 30 species of Umbelliferae naturalized in New Zealand, few of these are widespread. The two commonest species are the pungent-smelling, poisonous, tall, white-flowered hemlock, *Conium maculatum*, with its distinctive purple blotched and spotted stems, and fennel, *Foeniculum vulgare*, distinguished by its feathery leaves, yellow flowers and aniseed smell. Wild carrot, *Daucus carota*, in many dry areas, and wild parsnip, *Pastinaca sativa*, in damp situations along ditches, are also quite common.

A final draft of the members of this family has been prepared for the volume on the naturalized dicotyledons.

Flora of New Zealand: Grasses

(Dr H. E. Connor and Dr E. Edgar)

Since the last triennium, revisions of *Zoysia* Willd. and *Simplicia* T. Kirk were completed by the late V. D. Zotov. Current investigations are discussed below.

1. *Rytidosperma* Steudel (*Notodanthonia* Zotov)

The small tussocky grasses which are known in New Zealand by the common name "danthonia" are found throughout the country in a wide variety of habitats, from sea-level to 1800 m altitude. In 1963 Zotov (*N.Z. Jl. Bot. 1:* 78-136) segregated these plants from *Danthonia* DC. s.s. under a new genus *Notodanthonia.* In 1973 Nicora (*Darwiniana 18:* 80-106) showed that Steudel's genus *Rytidosperma* 1854 was set up to cover a South American danthonioid plant in which the hairs on the lemma were arranged in two distinct rows rather than scattered indiscriminately over the lemma as in *Danthonia* s.s. This arrangement of lemma hairs is also a characteristic of the New Zealand and Australian species placed by Zotov in *Notodanthonia,* and we agree with Nicora that *Rytidosperma* Steudel 1854 is an earlier name for *Notodanthonia* Zotov 1963. Accordingly we have transferred Australasian danthonioid species to *Rytidosperma* where appropriate (Connor and Edgar, *N.Z. Jl. Bot.* in press).

In our view the genus *Rytidosperma* comprises about 52 species of South America, New Guinea, Australia and New Zealand; we are unsure about some Asian species of *Danthonia.* For New Zealand we recognise 25 species, 9 naturalized from Australia, one common to New Zealand and Tasmania, and 15 endemic species of which three are newly described—one from rocky sites in montane grasslands in Canterbury and Otago, one from coastal rocks about Cook Strait, and one with a very distinct habit in which the slender culms elongate after flowering to over a metre and trail along the ground.

Both Zotov (1963), and Vickery (1956) in her revision of Australian danthonias (*Contr. N.S.W. Nat. Herb. 2:* 249-325), stressed the fact that the "characters of the lemma are regarded as providing the most diagnostic characters of the species" and we also found these the most dependable features on which to identify species. As well as the disposition of the lemma hairs within the two rows, we used other relationships between different parts of the lemma and palea, such as the relationship between the height of the lemma hairs and/or the palea, the relationship between the length of the lemma and the length of its lateral lobes, the relationship between the height of the awn column and the upper lemma hairs etc.

2. *Dichelachne* Endl.

The latest revision of *Dichelachne,* an Australasian-Malesian genus, is that of Veldkamp (*Blumea 22:* 5-12, 1974). He recognises 3 species,

D. rara (R. Br.) Vickery—subdivided into ssp. *rara* and ssp. *asperula* Veldkamp—*D. micrantha* (Cav.) Domin and *D. crinita* (L.f.) Hook.f. He records all taxa as occurring in New Zealand but made no statement as to their distribution within this country.

At present we distinguish five taxa in New Zealand. *Dichelachne crinita* occurs throughout the New Zealand region, except in the subantarctic islands. The remainder have all been known here as *D. sciurea*. The most common of these is the one named by Hackel *D. sciurea* var. *inaequiglumis*, based on a Petrie specimen from Western Park, Auckland. It is found in North Auckland, Auckland, Taranaki (one record), Wellington, northern Marlborough, Nelson, and Westland, and may be deserving of specific rank. It is certainly more closely related to *D. rara* than to *D. sciurea*. The two subspecies of *D. rara* have also been treated as *D. sciurea* in New Zealand herbaria; ssp. *rara* has a very scattered distribution—North Auckland, Auckland city, the Coromandel, Wellington near Cook Strait, Marlborough Sounds and Bluff; while ssp. *asperula* is very scarce indeed—Bay of Islands, Nelson, and Christchurch being the only recorded localities. The true *D. sciurea* (= *D. montana* Endl. of Norfolk Id) has an open, spreading, usually purple-tinged panicle which becomes more contracted when dried and resembles the panicle in *D. crinita*, but the spikelets are much smaller than those of *D. crinita* and the awns are shorter and finer and arise from higher up the lemma. Veldkamp equates *D. sciurea* R. Br. with *D. micrantha* (Cav.) Domin but we have not seen Cavanilles' type which is held at Madrid.

3. *Microlaena* R.Br.

The Australasian genus *Microlaena* is of uncertain relationship with other grasses, but the five species found in New Zealand are easily distinguished from each other. Bush rice grass, *M. avenacea*, is found throughout as a forest species; a rhizomatous plant of dry open sites *M. stipoides* is shared with Australia; *M. polynoda* occurs in both islands mostly scrambling among trees or shrubs. In aerially borne inflorescences *M. avenacea* and *M. polynoda* flower chasmogamously, but *M. stipoides* is both chasmogamic and cleistogamic. Clandestine axillary spikelets occur in *M. stipoides* and *M. polynoda*, in the former at ground level and in the latter in leaf axils up the long, many noded, much branched scrambling stem (Connor and Matthews, *N.Z. Jl. Bot. 15:* 531-34).

The two montane to alpine species, *Microlaena colensoi* and *M. thomsonii*, are very different in appearance and were formerly placed in *Ehrharta* Thunb. and in the illegitimate genus *Petriella* Zotov non Curzi. They seem closer to *Microlaena tasmanica*, especially its var. *alpina* than to the other New Zealand microlaenas.

4. *Cortaderia* Stapf nom. cons.

Six species of *Cortaderia* occur in New Zealand, four are endemic and members of Section Bifida, and two are naturalized South American species of Section Cortaderia. The two sections are told apart by the single prominent nerve in the blades of leaves of Section Cortaderia, and the several prominent nerves in leaf blades of Section Bifida.

All are prominent in horticulture, with the Argentinean species *C. selloana* the most widely used, and of the New Zealand endemics *C. fulvida* is the most widely sought after.

5. *Stipa* L.

There are six and most probably seven species of *Stipa* in this country; two are native, the maritime species *S. stipoides* which is shared with Australia, and the Central Otago endemic *S. petriei.* The other species are naturalized here from Australia or South America. The Australian species include *S. verticillata,* more commonly found in horticulture than elsewhere, and what has been called "*S. variabilis*", but seems to comprise two taxa, the precise names for which have not yet been determined. Both are characteristic of dry grasslands. The remaining species are South American, nassella tussock now found in both islands, and *S. neesiana* restricted to Marlborough.

Revisions: Flowering Plants

1. Myrtaceae

(a) *Eugenia* and *Syzygium* (Mr W. R. Sykes; Dr P. J. Garnock-Jones).

During the last forty years, most Malesian and Pacific species of *Eugenia* have been transferred to *Syzygium,* but the relationships of the endemic New Zealand species *E. maire* had not been considered. The floral anatomy and morphology of *E. maire,* a lowland swamp-forest tree occurring north of Marlborough, have now been studied. It was found to have closest similarities with the Old World genus *Syzygium,* rather than with *Eugenia,* a largely New World genus. A study of pollen of sixteen species belonging to *Eugenia, Syzygium* or related genera (with N. T. Moar) showed that pollen characters are not as useful at the generic level as some earlier, more limited, studies had suggested. A paper discussing the results and making a new combination for *Eugenia maire* in *Syzygium* is in press (*Journal of the Arnold Arboretum 60 (3)* 1979).

2. Compositae

(a) *Celmisia, Damnamenia, Pleurophyllum* (Dr D. R. Given)

Revision of *Celmisia* continues. A treatment of the group of species clustered about *Celmisia coriacea* has been submitted for publication.

The epithet "coriacea" is shown to be misapplied, the species usually known by this name taking the epithet "semicordata". This is a move which is unlikely to be greeted with enthusiasm by rock gardeners. Central Otago plants formerly known as *Celmisia coriacea* var. *stricta* are shown to belong to a previously unrecognised subspecies, var. *stricta* being restricted to silvery plants of western Otago and Southland. The *C. petiolata* group is currently being revised and this will necessitate several changes of epithets following critical examination of type material.

Further numerical analyses of the *Celmisia gracilenta* complex have been carried out by Dr David Ratkowsky, CSIRO, Tasmania. These have clarified conflicting results from earlier analyses, and suggest that the complex can be divided into three major groups (possibly representing species) with minor assemblages within them. One complication is that the type specimen of *C. graminifolia* (one of the earliest available names within the group) is not clearly associated with any other specimens in the numerical analyses. It probably belongs to a group of coastal or lowland populations that includes *C. major* and *C. adamsii* of northern North Island.

Fieldwork has established more precisely, the geographic limits of many taxa. Major valley systems in eastern South Island appear to be significant barriers to dispersal and several widespread species have their northern or southern limits determined by transverse valleys such as the Wairau, Waiau-Hope-Doubtful, and Waitaki. For example, *C. spectabilis* is abundant north of the Waitaki but is absent from similar country immediately south, *C. lyallii* and *C. angustifolia* reach an abrupt northern limit south of the Waiau Valley, and *C. traversii* is on most mountains north of the Waiau River but is known south of it only on Shale Peak and in eastern Fiordland. Fieldwork has also confirmed some examples of disjunctions. *Celmisia hookeri* is known only from northeast Otago except for one population in the Mataura River gorge near Mid Dome; *Celmisia ramulosa* var. *tuberculata* is a western and central Otago species with disjunct outliers on Mount Nimrod in the Hunter Hills and the Four Peaks area (both in Canterbury).

During the summer 1976/77, *Damnamenia vernicosa* and species of *Pleurophyllum* were studied in the field on Campbell Island. Reports of hybrids between *Pleurophyllum* species were confirmed, but no examples of *Damnamenia* × *Pleurophyllum* were found although sites from which this had been reported were closely examined. Some variation in *Damnamenia vernicosa* on Campbell Island is correlated with altitude; upland and lowland forms can be recognised in the field. Plants with yellow disc florets occur sporadically and a population consisting of only yellow-disced plants was found near the west end of Lyall Ridge.

(b) *Leucogenes* (Dr B. P. J. Molloy)

Recent studies of *Leucogenes,* locally known as edelweiss, have shown that at least three species, one of them unnamed, occur in the wild. Examples of different populations of these species and other probable entities within *Leucogenes* are being cultivated at Lincoln for further studies, including chromosome analysis with Mr E. J. Beuzenberg, and a survey of phenolic compounds with Mr A. W. Purdie.

(c) *Pachystegia* (Dr B. P. J. Molloy and Mrs M. J. A. Bulfin)

Work has begun on the distribution, taxonomy and general ecology of the species of *Pachystegia.* So far three species are recognised, one of them unnamed. Examples of these and other probable entities within *Pachystegia* are being cultivated at Lincoln, and a paper chromatographic survey of the phenolics found in *Pachystegia* is being undertaken jointly with Dr J. Hemmingson, Chemistry Division, DSIR.

3. Scrophulariaceae

(a) *Hebe* and *Parahebe* (Dr P. J. Garnock-Jones)

A biogeographically interesting addition to *Hebe* is *H. rapensis* (*N.Z. Jl. Bot. 14:* 79-83, 1976), the only species of *Hebe* which does not grow in New Zealand. *H. rapensis* is endemic to Rapa Island in French Polynesia. It is most similar to the three species of *Hebe* from the Chatham Islands but also similar to those from small islands off New Zealand's northern coasts. On Rapa there are species of *Myoporum, Olearia, Pittosporum* and *Weinmannia* which are apparently closely related to New Zealand species.

The infraspecific taxonomy has been studied of two species of *Parahebe.* Two subspecies have been described in *P. linifolia,* separated by adaptations to two pollination systems (*N.Z. Jl. Bot. 14:* 285-289, 1976). In *P. catarractae,* a widespread and very variable species, four subspecies are recognised. These four subspecies, which have allopatric distributions, have been distinguished on morphological and chemical criteria. This work is now being prepared for publication, in conjunction with Mrs H. J. Langer of the Botany Department, University of Canterbury.

4. Papilionaceae

(a) *Carmichaelia* (Mr A. W. Purdie)

It is evident from field studies of *Carmichaelia* that the majority of species as currently listed are not clearly defined. Overlapping of species with common characters, and variation of individual characters within species result in widespread confusion when efforts are made to identify plants. Many genetically inherited characters (e.g. pod size, pod dehiscence, seed colour), persisting as a result of

prolonged inbreeding, are restricted to specific, and often relatively small, areas and populations. However, infraspecific variation, which is so common in *Carmichaelia* and which is manifested in a wide range of forms and characters, is very much the product of prevailing environmental conditions. The level of intraspecific variation involved is being studied; should it prove to be continuous, the number of taxa will have to be greatly reduced. Representatives of *Carmichaelia* from localities throughout New Zealand are being propagated, grown, and studied under uniform conditions in the Botany Division gardens. Observations will be made over a number of seasons.

Investigation of seed proteins and enzymes have proved unhelpful in clarifying the taxonomic situation in *Carmichaelia.* However, analysis of flavonoids is proving a valuable taxonomic aid. Preliminary work has involved Two-Dimensional Paper Chromatographic analysis of the naturally occurring flavonoid glycosides and flavonoid aglycones. Over 150 analyses have been made of plant material representing collections of *Carmichaelia* from North Auckland to Southland. Further analysis of aglycones by Thin-Layer Chromatography, following acid hydrolysis of the natural glycosides, is proving valuable in establishing relationships within the genus. Combinations of units of *Carmichaelia,* which are biochemically related according to their flavonoid aglycones, will be used as a basis for the taxonomic reassessment of the genus.

5. Rubiaceae

(a) *Coprosma* (Mr A. P. Druce)

In "Flora of New Zealand, Vol. I", H. H. Allan, like Cheeseman ("Manual N.Z. Flora" 1925), recognised about 45 species in *Coprosma.* A current estimate is 50 species and five subspecies, with eight species as yet undescribed. All are in cultivation at Upper Hutt. The form, shape and size of the stipules has been constantly used as a discriminating character in the genus; illustrations of all are ready for publication to accompany the descriptions of new species, and an annotated checklist of all taxa has been made.

I am unable to support the long list of interspecific hybrids referred to for *Coprosma* (see H. H. Allan "Flora N.Z." I: 587, 1961), but find that *C. propinqua* crosses with *C. macrocarpa, C. robusta* and *C. tenuifolia.*

6. Viscaceae and Loranthaceae (Dr B. P. J. Molloy)

New Zealand mistletoes are now classified into two families: Viscaceae, including the dwarf mistletoes (*Korthalsella*), and Loranthaceae, including the large leafy mistletoes, listed under the genera *Tupeia, Loranthus* and *Elytranthe* in the current "Flora of New Zealand". Dr B. A. Barlow (*Australian Journal of Botany 14:* 421, 1966) revised the New Zealand Loranthaceae, retaining the genus

Tupeia, and restoring four abandoned van Tieghem genera *Ileostylus, Peraxilla, Alepis* and *Trilepidea* in place of *Loranthus* and *Elytranthe*. A recent survey of the phenolic biochemistry of New Zealand mistletoes with Dr K. R. Markham, Chemistry Division, DSIR, supports Dr Barlow's treatment of Loranthaceae, and confirms the three species of dwarf mistletoe recognised by Cheeseman ("Manual of the N.Z. Flora" 1925), namely: *Korthalsella lindsayi, K. clavata* and *K. salicornioides*.

7. Fagaceae (Dr G. N. Park)

The identity of black beech, *Nothofagus solandri* var. *solandri*, and mountain beech, *N. solandri* var. *cliffortioides*, at their respective low and high altitude extremes is a simple matter. However in many mid-altitude sites the genetic nature of the population is intermediate and more complex. This commonly leads to confusion in the naming of the many vegetation forest types to which both taxa contribute as major dominants. To investigate this some 50 populations have been sampled on the basis of selecting 20 leaves of constant age from the crown foliage of each of 10 adult trees. A series of radial measurements has been made of each leaf. In association with D. Rhoades, Applied Mathematics Division, DSIR, a computer programme using Fourrier Analysis has been developed that allows a single equation describing leaf shape to be subjected to statistical analysis. All indications are that *Nothofagus solandri* is a clinal species, typified by mountain beech. Black beech may have arisen from low frequency introgression between this species and hard red beech.

8. Gramineae

(a) *Chionochloa* and *Cortaderia* (Dr H. E. Connor and Mr A. W. Purdie)

The triterpene methyl ethers isolated in these two genera were identified (*Phytochemistry 15:* 1933-35, 1976) and the inheritance of their synthesis in *Cortaderia* shown to be controlled by dominant genes (*Phytochemistry 15:* 1937-39, 1976). These latter investigations were made on experimental interspecific hybrids. Evidence of identical genetic control in *Chionochloa* was found in naturally occurring interspecific hybrids between a species that does not synthesise triterpene methyl ethers and one that does; the hybrids yielded cycloartenol methyl ether, the sole triterpenoid found in one species. At the infraspecific level evidence of exchange of a dominant gene for β-amyrin methyl ether synthesis was detected.

Analyses further to those discussed earlier (*N.Z. Jl. Bot. 14:* 315-26, 1976) indicate that in *Chionochloa rigida* the β-amyrin methyl ether chemodeme extends deep into Fiordland, and that the upland cycloartenol methyl ether chemodeme of *C. rubra* extends north to

the Paparoa Ranges in Westland. Some other geographic boundaries of infraspecific chemodemes are extended if only slightly, and others are reinforced.

For some taxa there were few samples, e.g. *C. pungens* from Stewart Island was sampled only once; extended sampling of this and other taxa have not shown any departures from the ground plan of triterpene methyl ether chemodemes already indicated for the taxa investigated.

Revisions: Ferns and Fern Allies

(Dr D. R. Given)

1. *Blechnum procerum* complex

Cultivation of plants from a wide range of localities and habitats, extensive field collections and examination of herbarium specimens shows that this troublesome complex probably consists of four species, one of which includes two subspecies. Supporting evidence comes from flavonoid chemistry. Chromosome numbers are not yet known for all of them and the exact application of the epithet "procerum" is still uncertain. It is now known that *B. capense* does not occur in Australasia, and the application of the epithet "minus" in New Zealand has been clarified—it applies to a distinctive species of wet habitats described by Colenso as *Lomaria capense* var. *gracilis*.

2. *Grammitis*

Most live collections of this genus have failed to survive in the glasshouse, and cytological work is still to be done on most species. Further field work has established with more certainty the geographical range of the species, especially in the Subantarctic, North Island, and West Coast of the South Island. In January 1979, *G. rawlingsii* was re-collected in the field. Formerly, it was known only from the type collection. It probably occurs in low numbers through kauri forest of North Auckland.

3. *Pleurosorus*

Little progress has been made on this genus since the last report. Gametophytes of *P. hispanicus* succumbed to fungal attack and efforts are now being made to get young sporophytes of this to compare with the Australasian *P. rutifolius*.

4. *Loxoma*

Loxoma (New Zealand) and *Loxomopsis* (Central America) are two primitive fern genera whose affinities have long been disputed. They are the only members of the family Loxomaceae, and relationships have been suggested with groups as diverse as the Dennstaedtiaceae, Hymenophyllaceae and Dicksoniaceae. Flavonoids

of *Loxoma cunninghamii* and *Loxomopsis costaricensis* have been determined by Dr K. R. Markham of Chemistry Division, DSIR. Results indicate that chemically the two species are closely allied despite their geographical isolation (*Biochemical Systematics and Ecology*, in press). Analysis of possible relatives among other fern families is being carried out as material becomes available.

5. Hymenophyllaceae

The filmy ferns have long been the subject of taxonomic investigation at the generic level. The number of genera accepted varies from two (*Hymenophyllum* and *Trichomanes*) to over thirty. Most New Zealand, and some overseas species, have been examined and flavonoid analyses by Dr K. R. Markham support the concept of many genera, especially among the smaller-fronded species.

6. *Lycopodium*

Preliminary studies of all New Zealand species indicate that these separate out into three groups, each with a distinct flavonoid pattern. Work is being extended to overseas species for comparison with New Zealand taxa. An account of the New Zealand section of the study is in preparation; this includes an assessment of the contribution made to an understanding of *Lycopodium* taxonomy at the generic level.

7. Living collections

Approximately 80 species are maintained in cultivation at Lincoln and this material is proving extremely useful for a variety of purposes: exchange material, chemotaxonomy, cytology, description of features not easily seen on herbarium specimens, propagation, spore studies and frost tolerance studies.

Preliminary exposure of selected species to various levels of freezing indicates that sensitivity to frost levels may be an important factor in determining distribution of ferns. Some species of the northern half of the North Island are killed by exposure to 3-4°C of frost, whereas *Polystichum cystostegia* is undamaged at temperatures as low as −18°C.

8. Geographic studies

The geographic distribution of New Zealand pteridophytes can be grouped into nine assemblages by comparison of distribution maps and grouping together those taxa with similar distributions. If it is assumed that most species are capable of wide dispersal of spores, the distribution patterns probably approximate the distribution of available habitats, and species within each assemblage would be expected to have similar ecological requirements. This aspect of distribution is being looked at, for example, through the frost sensitivity studies mentioned above.

An account of the pteridophytes of Banks Peninsula is close to

completion and chiefly awaits final field work in the eastern part of the peninsula. Recent visits to this area have resulted in the rediscovery of *Anarthropteris lanceolata* and *Pteris tremula* which were thought to be locally extinct, while collections of the locally rare *Asplenium trichomanes, Hymenophyllum minimum,* and *Grammitis ciliata* have been made near Carews Peak.

9. Names of New Zealand pteridophytes

For some years a card index of binomials has been maintained at the division. This is being checked against a list assembled by Dr P. J. Brownsey (National Museum) with a view to publishing a list of all generic and specific names which have been used in the New Zealand botanical region. Where known, type specimens will be indicated. Professor J. D. Lovis (University of Canterbury) is also contributing to this list.

Revisions: Lichens

(Dr D. J. Galloway)

The lichen family Stictaceae in New Zealand contains the genera *Lobaria, Pseudocyphellaria* and *Sticta,* with *Pseudocyphellaria* being more richly represented in New Zealand than in any other country, apart, possibly, from South America. *Pseudocyphellaria* is characterised by pseudocyphellae on the lower surface, emergent laminal or marginal apothecia containing spores which are colourless or brown and 1–3-septate or polarilocular, and a diverse chemistry consisting of orcinol derivatives, β-orcinol derivatives, triterpenoids, terphenylquinones and pulvic acid derivatives. The chemistry of *Lobaria* is less rich than that of *Pseudocyphellaria,* the spores are fusiform or linear-acicular and 3–7-septate, present in laminal, emergent apothecia and neither pseudocyphellae nor true cyphellae are present on either upper or lower surfaces. *Sticta* has true cyphellae on the lower surface, laminal emergent apothecia containing colourless or brown 1–3-septate spores which are never polarilocular, and a chemistry deficient in orcinol, β-orcinol compounds or triterpenoids, dominated by simple amines and soluble carbohydrates especially 4-8 carbon sugars and polyhydric alcohols.

Recent revisions of these genera in New Zealand have disclosed taxonomic misinterpretations of many species, especially in *Pseudocyphellaria* where some species have up to 20 different synonyms. Forty-one species of *Pseudocyphellaria* are recognised in the New Zealand flora and of this number eight are undescribed. New Zealand is a centre of speciation in this primarily southern hemisphere genus and besides a strong endemic element, there are close links between South American and eastern Australian populations, and as well a small group of cosmopolitan species. Many species appear to have

both blue-green and green algal morphotypes and often the two forms are present in single plants. Unlike the lichen chimeras found in *Lobaria* and *Sticta*, the blue-green morphotype is indistinguishable (except in colour when wet) from the plant having green symbiotic algae and there seems no tendency for ± fruticose, *Dendriscocaulon*-like structures to be formed.

Revisions of other New Zealand lichen genera include: *Baeomyces, Siphula, Stereocaulon* and *Argopsis, Hypotrachyna, Parmelia, Parmelina, Pseudoparmelia, Parmotrema, Xanthoparmelia* and the Pannariaceae.

A New Zealand lichen flora comprising some 140 genera and including taxa from crustose genera should be completed by the end of 1979.

Continuing and projected field work includes: a lichen survey of Northland (with J. Bartlett); the high-alpine lichen vegetation of the Canterbury foothill ranges (with B. P. J. Molloy); lichens of the Lewis Pass Scenic Reserve (with N. Simpson); lichens of Stewart Island (with H. D. Wilson); and lichens of subalpine peat bogs in Otago and Southland.

Historical work involves the preparation of a history of lichenological exploration in New Zealand (1770-1970); the lichen collections of Archibald Menzies, made on his three important voyages as surgeon to "HMS Assistance" on the Halifax Station of 1784-1786; as surgeon to James Colnett's circumnavigation of 1786-1789 in the "Prince of Wales"; and as naturalist-surgeon on Vancouver's circumnavigation in "HMS Discovery" (1791-1796); and the influence of Erik Acharius and Olof Swartz on the development of lichenology in England between 1799 and 1814.

Revisions: Marine Algae

(Dr M. J. Parsons)

Carrageenan analyses of *Gigartina*, a red seaweed, were discussed in the 1972-75 triennial report, and the first two publications from these analyses were described. Geographical variation and interspecific differences of the total carrageenan, K—, —, and μ— carrageenan of 12 species of *Gigartina* was published in *N.Z. Journal of Botany 15:* 589-95, 1977. These results suggested that there is no significant difference between samples of the same species taken from different geographical areas, but that there may be significant differences between either individual species or groups of species. Collections of various species of *Gigartina* will continue, to obtain material for a taxonomic and morphological study later.

Taxonomic and morphological studies on species of the families Rhodomelaceae and Dasyaceae continue and those on *Brongniartella* (*B. byssoides* and *B. australis*) are very near completion. The latter

will illustrate an interesting variation in procarp structure for the family Rhodomelaceae. A start has been made on similar studies for the genus *Heterosiphonia.*

From September 1975 to January 1976, Professor Richard D. Wood, and his wife Urda, worked at Botany Division preparing a monograph on the Charophyta. While the paper was being printed, Professor Wood became ill, and later died. The manuscript was seen through the press (*N.Z. Jl. Bot. 15:* 87-180) by Miss Ruth Mason and Dr Parsons.

Dr Murray H. G. Monroe, his colleagues and students of the Chemistry Department, University of Canterbury, are interested in working on biologically active compounds found in red seaweeds especially those in *Plocamium.* Samples of these seaweeds have been identified for them and voucher specimens made for the herbarium.

The binomial index to algal names used in the New Zealand flora continues to increase in size as names from older publications are entered. This index covers about 700 seaweed species found in New Zealand and consists of about 1800 names so far.

Revisions: Freshwater Algae

(Dr Vivienne Cassie)

Two new freshwater algae have been found in New Zealand—one a diatom belonging to the mainly marine genus *Thalassiosira,* and the other a very small *Chlorella,* have been investigated with Dr G. P. Dempsey and Miss Diane Lawrence, Plant Diseases Division, DSIR, for their ultrastructure by scanning and transmission electron microscopy.

The small central diatom *Thalassiosira* was found growing in oxidation ponds with a high chloride content in the vicinity of Auckland, and differs from other species in a sufficient number of characters to warrant recognition as a new species. The main differences concern the number and position of eccentric strutted processes, the structure of the areolae of the valve and the valve mantle, and the nature of the girdle. Its nearest relative appears to be Kenyan. The membrane covering the inner surface of the valve has been shown by transmission electron microscopy at extremely high magnifications to consist of minute tubular pores. This feature has not yet been demonstrated for any other diatom, although the membrane itself is well known.

The isolation of a new species of *Chlorella,* a unicellular eucaryotic green alga (i.e. with cell constituents similar to those in higher plants) was made from the stagnant inshore waters of Lake Pupuke, North Shore, Auckland. It appears to like growing together with other micro-algae, and is stubbornly resistant to attempts to obtain uni-algal cultures. By freeze-fracturing techniques and a series of ultra-thin

sections, a model of the cell, which is not more than 3 μm in diameter, has been constructed. A unique feature is the close association of mitochondrion and chloroplast.

Reproductive Systems

1. Secondary sex characters in seed plants (Dr C. J. Webb)

Secondary sex characters are differences between males and females of sexually dimorphic species in characters other than sex itself. In collaboration with Dr D. G. Lloyd of the University of Canterbury, an attempt has been made to bring together the information available for both cultivated and wild plants and offer a general explanation for the distribution and occurrence of secondary sex characters (*Botanical Review 43:* 117-216, 1977).

In many monocarpic and short-lived species, including hemp and spinach, females are larger than males. In asparagus males exceed females in total growth but individual shoots of females are larger.

In a number of perennial species males exceed females in vigour, growth rate or vegetative reproduction. In some long-lived species a greater survival rate of males contributes to a predominance of males in populations. In many species males flower at an earlier age, flower earlier in a season and for longer, and produce more flowers and inflorescences than females. In a few species males and females have different micro-distributions within a habitat.

We have postulated that many of these secondary sex characters are a result of the greater demand made on females by reproduction, as females produce ovules and also mature seeds whereas male investment in reproduction ends at anthesis. This hypothesis seems to explain the occurrence of many secondary sex characters.

2. *Parahebe* (Dr P. J. Garnock-Jones)

A survey of pollination adaptations in New Zealand *Parahebe* has been published (*N.Z. Jl. Bot. 14:* 291-298, 1976). All New Zealand species are homogamous, self-compatible, hermaphrodites. Lowland, widely distributed species are adapted to insect-pollination, whereas most species occupying various subalpine, alpine and nival habitats are adapted to autogamy. The entomophily and autogamy syndromes are described and illustrated.

PACIFIC ISLANDS

1. Kermadec Islands (Mr W. R. Sykes)

The publication of the "Kermadec Islands Flora: An Annotated Checklist" in 1977 was the culmination of several visits there during the previous 12 years and all species known to have occurred in the Kermadec group except for a few ephemeral cultigens are listed with

a comment on their status and distribution. Sometimes a taxonomic discussion follows and the status of three endemic taxa is changed. The introduction includes an outline of the physical features of the Kermadecs, the history of human influence there and statistics of the flora.

In the period under review assistance was given with the drafting of a management plan for Raoul Island by the Lands and Survey Department, the administering body for the Kermadec Islands, except for a small area around the Meteorological Station on Raoul. Apart from this enclave the Islands have been assigned the highest category of reserve.

Visits in November 1976 and February 1978 were primarily undertaken at the request of the Outlying Island Reserves Committee to assess progress over the control of noxious weeds on Raoul and to study the regeneration of vegetation there as a result of the pressure on the feral goats maintained by yearly shooting expeditions organised by the Forest Service. Despite prolific regeneration from seed of *Caesalpina decapetala*, Mysore thorn, there has been very encouraging progress made towards controlling this serious weed; cf. the comments in the last Triennial Report.

Whilst surveying Raoul in order to observe regeneration of species palatable to goats, the opportunity was taken to monitor the occurrence of the rare indigenous species generally. In 1976 the opportunity was also taken to study the plants of South Chanter Islet, a few kilometres east of Raoul. The flora was compared with observations made a decade earlier and it was clear that there had been almost no change on this practically unmodified piece of land. Finally, in 1978 two short visits to the larger North Meyer Islet enabled a quadrat to be mapped and observations to be made on the status of the few rare species there as well as that of certain potentially noxious weeds. Fortunately none of the latter category of plants seemed to have increased since 1967 on this very important mammal-free islet.

2. Tonga (Mr W. R. Sykes)

The need to carry out botanical investigations in the Kingdom of Tonga was mentioned in the Triennial Report for 1972-75. In 1977 the Royal Society of New Zealand's Expedition to the S.W. Pacific included a study of the flora of 'Eua, probably the oldest island in the group as well as one of the richest floristically. The general collection made included a number of species hitherto unrecorded there. Whilst more work has still to be done on the flowering plants, an account of the pteridophytes has been written.

As a sequel to this expedition, a botanist in the Peace Corps working for the Tongan Government has collected for Botany Division on some of the other islands, notably in the volcanic chain running down the west side of Tonga. These islands are mainly sparsely

inhabited and their floras have been very poorly investigated. In November 1978 a combined Botany Division and Peace Corps expedition to Late, W.S.W. of Vav'au in Northern Tonga made the first detailed study of this uninhabited volcano. In addition a short period was spent on Vav'au itself, a large dissected and uplifted older coral island which must have been an important source for many species on the volcanoes. However, it is noteworthy that some species on the latter are not found elsewhere in Tonga and a few are endemic, mainly towards the crater summits. Evidence now shows that within Tonga several species, particularly pteridophytes, hitherto recorded as growing on 'Eua only, also grow on one or more of the volcanoes, notably Kao whose summit of 1000 m is the highest land in the Kingdom. Introduced weeds and cultigens have been intensively collected, particularly on Tongatapu, Vav'au and 'Eua.

3. Cook Islands (Mr W. R. Sykes)

Although no field work has been done in the 1976-78 period, intermittent studies of plants collected in 1974 and 1975 are enabling a more accurate picture of the flora to emerge. Apart from a modern account of Aitutaki and two older and more inadequate accounts for Rarotonga, little has been published on the islands in the Southern Cooks. As a preliminary to detailed floristic accounts, a comprehensive bibliography of literature pertaining to the vegetation of the whole of the Cook Islands has been compiled. In addition short general accounts of the vegetation of the islands in the Southern Cooks have been written for Soil Bureau. An account for Palmerston Atoll for the Cook Island Museum Society includes a species list for this floristically poor atoll.

4. New Caledonia

In October 1977 an expedition to New Caledonia was organised and led by members of Entomology Division, DSIR. Dr P. N. Johnson was a member of the team and he assisted the entomologists by identifying host plants. In addition, he collected herbarium specimens for botanical taxonomists and chemists.

5. Fiji (Dr P. J. Garnock-Jones)

The Lau Group of Fiji, situated midway between Viti Levu and Tonga, has rarely been visited by botanists and no account of its vegetation and flora has been published. The Royal Society of New Zealand expedition to Fiji and Tonga provided an opportunity to spend 3½ weeks on the two principal islands of the group to collect representatives of their flora and to describe their vegetation. A collection of 380 numbers was made for CHR and some duplicates were sent to BISH and SUVA. Professor A. C. Smith (Honolulu) very kindly examined the whole flowering plant collection and his comments and identifications were most valuable. Professor Smith has

cited many of the specimens as distribution records in his "Flora Vitiensis Nova" of which part I has already been published. A classification and description of the major plant communities on the two islands has been published (*Royal Society of New Zealand, bulletin 17:* 95-117).

The islands visited, Lakeba and Vanua Balavu, are each of about 50 km² and composed of both volcanic rock and limestone. The coastal strand vegetation differs little from strand vegetation throughout the Pacific. Mangrove forests are a simple community dominated by *Rhizophora* and *Bruguiera*. Their distribution is governed by sediment and shelter. Forests dominated by *Dysoxylum richii* and *Maniltoa floribunda* remain only as small pockets near heads of valleys and on limestone outcrops following extensive and repeated land-clearing fires during 3000 years of human occupation. Most of the volcanic parts of both islands support tall *Miscanthus* grassland on deep soils and fernland and scrub on shallow soils. On areas not recently burnt some regeneration of forest is beginning. This younger forest is dominated by *Alphitonia zizyphoides, Grewia crenata* and *Macaranga harveyana*.

Some attention was paid to weedy plants on both islands as any future economic development is likely to involve horticulture. Several declared noxious weeds (e.g. *Hyptis pectinata, Psidium guajava* and *Urena lobata*) are well established.

ECOLOGY, VEGETATION SURVEY AND CONSERVATION

(Dr P. Wardle)

This section covers two fields, which are different and yet closely related. Ecology deals with the relationships between living organisms and their environment, and yields information on why plants grow where they do, how vegetation has developed its composition and structure, and how it will react to changes, whether natural or caused by man. Vegetation survey is a stock-taking of existing resources of plant species and communities, and is essentially descriptive and enumerative. It provides the ecologist with topics on which to carry out research, and ecological research in turn can provide a basis for selecting and managing areas of vegetation for defined purposes.

Most of the ecologists in Botany Division were appointed during a period of enhanced environmental awareness, and their surveys are related almost entirely to nature conservation. Ecological research in the Division similarly leans towards conservation problems, although fundamental problems in New Zealand ecology also receive attention.

The triennial period 1976-78 may well represent an apogee of conservation-oriented botany. At its beginning, New Zealand had

Photo: J. Somers Cocks

Mr A.J. Healy M.Ag.Sc. (N.Z.) who was appointed to Botany Division staff on 1 April 1941, and retired on 3 March 1977. Arthur Healy was Assistant-Director for 25½ years.

Photo: Ivor Davey

Inspecting a crop of Linum at the Waiwhetu Experimental Station in late 1942. l. to r. Ruth Mason, Dr Allan, David Cairns (Officer-in-Charge, Waiwhetu), Lai-Yung Li, Lucy Moore, Dr Hamilton, Mary Sutherland, Arthur Healy, George Briggs (foreman, Waiwhetu).

Botany Division headquarters on the south-east corner of Latimer Square with Hereford Street (1955).

Photo: C.J. Miles

The official opening of the Botany Division building at Lincoln on 19 September 1960. Official party l. to r.: Dr F.J. Llewellyn (Vice-Chancellor University of Canterbury and member of the Council of Scientific & Industrial Research); Dr M.M. Burns (Principal, Lincoln College, and Chairman of the Council, Scientific & Industrial Research); Hon. P.N. Holloway (Minister in Charge of Scientific & Industrial Research); Dr W.A. Joiner (Deputy Secretary, DSIR); Dr E.J. Godley (Director, Botany Division); Mr A.J. Healy (Assistant-Director, Botany Division).

reached an unprecedented height of prosperity and economic activity, which led to great pressures on the natural environment. For Botany Division, a direct result was that the number of staff assigned to ecology and vegetation survey also reached a maximum. Then, the oil crises and other economic disturbances ushered in a period of retrenchment. While this has meant that Botany Division has been unable to fill staff vacancies, let alone expand its ecological coverage of New Zealand, it may also provide a respite from the pace of development and modification of the landscape. Accordingly, there should be an opportunity to consolidate on the survey activity of the last three years, to expand survey into areas of vegetation not immediately threatened by development, and to spend more time on basic ecology.

The contents of this section, including the list of unpublished reports, indicate the extent to which Botany Division has been requested for information and advice on vegetation, especially by the Department of Lands and Survey; and as much information has arisen from the Division's own initiative. It would be rewarding to be able to claim that this effort has led to a fully adequate network of reserves, especially of the more vulnerable lowland plant communities. However, the mills of State grind slowly in matters of conservation; investigating and actioning reserve proposals demand a large commitment of time on the part of officers of the land-administering departments, economic and political complications arise, and even after a reserve has been approved in principal, the administrative and legal formalities that precede firm gazettal can take years. The following table has been prepared, to indicate the extent and effectiveness of Botany Division involvement. Column I shows the category of land ownership; II the number of separate areas over which Botany Division has proposed reserves during the period 1971-78, or has contributed significantly to such proposals; III the number of these proposals that have been accepted and acted on in whole or greater part, to the extent that eventual reservation is probable; and IV, the number of reserves that have been gazetted. The data covers the whole of New Zealand except south of the Cook River in Westland where, although Botany Division has been involved in reserve recommendations, these have been tentative in view of the need for further information. The numbers are necessarily approximate, but have been used instead of areal data which would have been still less accurate. However, a total approaching 100,000 ha is involved, in individual proposals that range from one of 20,000 ha down to small pockets of land needed to rationalize existing reserve boundaries.

I	II	III	IV
Crown Land	83	28	6
State Forest	15	10	0
Private, Maori and other	53	15	4

These figures are reasonably encouraging, and justify Botany Division's continuing activity in this sphere. The most frustrating aspect, for the scientists involved, is that they are usually "in the dark" regarding progress on proposals that they make and it would be very helpful if an administrative procedure could be developed that would overcome this.

Ecology

1. Forest Ecology

Beech forests and their relationship to other forest communities are a continuing research interest at Botany Division. During the period, Mr S. R. June continued his study of the boundaries between beech stands and species such as rimu, miro, and rata in North Westland, and although he has recently resigned, his results will appear as a thesis. Mr Allen has commenced a similar study at the University of Otago, on the relationships between silver beech and the surrounding podocarp-hardwood stands in the Catlins district. In South Westland, Dr Wardle has also been working in the Paringa district, where silver beech forms ecotones with other forest types, at localities ranging from the sea coast to timberline. It is generally evident that beech is very slowly invading contiguous communities, and that it also has an ability to be successfully dispersed over distances of several kilometres. In all districts the spread has been taking place through the post-glacial period, and useful evidence on this has been yielded by fossil material from localities in Fiordland and South Westland.

Near Lake Rotoroa (Nelson), Dr Park has been studying the age structure in montane beech stands which have regenerated after being blown down in a storm in July 1867. Thirty years was required for the canopy to close, and at first red beech was dominant, but it is being replaced by silver beech. In the far more complex lowland forests west of the Paparoa Range, the patterns of species diversity across gradients of forest composition and environment have been described as a prelude to mineral element analyses of plants growing across the same gradients. On the other side of the island, in the Clarence valley, age structure and regeneration in stands of *Podocarpus hallii* bear a relationship to fires occurring before and after European settlement in the 1850s. Further inland, in the upper Wairau Catchment, vigorous peripheral expansion of mountain beech stands seems related to effective control of wild animals and withdrawal of sheep over recent decades.

2. Timberline Studies

Measurement of growth and survival of a number of timberline tree species established at an altitudinal series of plots in the Craigieburn Range is continuing. The main present interest is in

the effect of the environment on the growth form of the few hardy conifers that survive above the natural timberline of mountain beech, but because of their very slow growth, the experiment is long-term. Dr Wardle and Mr Campbell have also collected winter shoots of various native trees and sent them to Professor A. Sakai of the Institute of Low Temperature Science at the University of Hokkaido, Japan, for testing cold resistance under controlled conditions. The results (published in *N.Z. Journal of Ecology 1:* 51, 1978), accord well with ecological distribution, *Dacrydium bidwillii* being the hardiest; but even this species does not approach the cold tolerance of many trees from high altitudes and latitudes in the northern hemisphere.

3. Phenology

Mr Campbell has completed field work for investigations of the relationship between shoot growth and growth ring formation in *Podocarpus totara,* and periodicity (i.e., variation from year to year) of flowering in celmisias, aciphyllas, and snow tussocks. Data has now been collected over eight seasons for a study of periodicity of seed production in totara, matai and kahikatea at Peel Forest (Canterbury).

Mr Walls is also studying seasonality and periodicity of flowering and fruiting of major species in podocarp stands in the Rai Valley (Marlborough) and D'Urville valley (Nelson Lakes National Park), with a view to providing information on food sources for native birds.

4. Biology of Weeds and Adventive Plants

This is primarily the responsibility of Dr Williams. He has shown that control of blackberry in North Auckland is complicated by the presence of three distinct kinds with different distributions, information which incidentally will assist in taxonomic revision of *Rubus* in New Zealand.

Buddleia davidii has become a problem within the Urewera National Park and adjacent Scenic Reserves, and Dr Williams has reported on its role in the landscape there. It rapidly colonises a wide range of open sites, especially in riverbeds and in the vicinity of logging operations. In time (10-15 years) buddleia can be replaced by native species but, because it suppresses native species in some habitats and alters the course of plant succession wherever it grows, it should be controlled within National Parks and other areas established for the preservation of indigenous biota. Because buddleia is extremely difficult to eradicate, efforts should be directed primarily at controlling its further spread.

Most of our former native grasslands in the semi-arid zones of South Island are now dominated by adventive plants. With few exceptions, these communities are poorly described in the literature. Two species that have been studied at Botany Division are *Vittadinia*

triloba, an Australian desert plant that appears especially well adapted to harsh conditions in North Otago, and sorrel (*Rumex acetosella*), where it dominates large areas in the Mackenzie Basin.

A report was submitted to the Department of Lands and Survey on the distribution of gorse, broom and tree lupin in the riverbeds of Canterbury, as the Crown is now legally responsible for controlling the noxious weeds on its lands, including riverbeds. Broom (*Cytisus scoparius*) is one of the most important plants of riverbeds and extensive grazing lands, but there is little known about its ecology. Studies have been carried out on the distribution of broom and gorse seeds in recently deposited alluvium. At one site, about half of them emerged as seedlings over the first summer after the depositing flood. In contrast, only 10 per cent of fresh broom seeds, collected from adjacent bushes and buried in nylon mesh bags, germinated within the first year of being buried in stable alluvium. Broom is therefore markedly hard-seeded in this environment, but despite the effects of time and the scarifying action of being moved within river gravels, there still remains a pool of seed in alluvium after the first year's flush of seedlings.

Seeds of the Californian desert plant, tree lupin (*Lupinus arboreus*), were buried too, but most germinated within the first year. This probably helps explain its more restricted distribution in Canterbury riverbeds, for there would be fewer viable seeds available for redistribution in alluvium, either by man or water.

Trials are being laid down to obtain better quantitative data on broom germination. The response of broom seed to varying depths of burial in sand and shingle has been measured, as have the effects of shade, soil type, and superphosphate on the growth of the seedlings.

Several plots containing broom plants of known age from the same population have been established in riverbeds and on mountain lands up to 1250 m a.s.l. to examine the seasonal pattern of growth, phenology, and seed production, and several points have already emerged. For example, at low altitudes on favourable sites, individual bushes can have two discrete periods of flowering and seed production, the second producing fewer flowers, smaller pods and slightly smaller seeds than the first. On harsh riverbed sites, and at higher altitudes, only one seed crop is produced.

Following opportunities to comment on the management plans for the Kaweka and Ruahine Forest Parks, Dr Atkinson prepared a case for the Nature Conservation Council against the further use of *Pinus contorta* for erosion control in North Island mountains. An analysis of the hydrological and sediment transport arguments that are usually given as reasons for the use of *P. contorta* in high mountain catchments shows these arguments to be tenuous. The continued use of *P. contorta* for erosion control does not appear justified in view of the risk of this plant spreading through many areas of as yet unspoilt indigenous mountain landscapes.

5. Animals and Vegetation

Many reserves of native vegetation are influenced by introduced mammals, and conversely, effective protection of some of our rarest native animals may depend on adequate knowledge of the vegetation they live in. Advice is sought from Botany Division in both contexts.

Mr Lee assists Wildlife Service in the takahe area in Fiordland, with studies of the plant habitat, plant nutrients, and general bird-vegetation interactions. Dr Johnson has carried out vegetation surveys in all known kakapo habitats in Fiordland. Botany Division has also supplied vegetation descriptions for areas delineated by the Fiordland National Park Board in the Hollyford valley for studying rodents and mustelids.

Dr Atkinson is continuing research on the effects of rats on fauna and flora. Following an earlier study of the spread of ship rats (*Rattus rattus*) in New Zealand, he has re-examined the historical evidence relating to its spread in Hawaii, and concludes that ship rats did not establish and spread through the Hawaiian Islands until after 1870, nearly a century later than usually assumed. There is circumstantial evidence for this having caused declines or extinctions in more than 50% of the islands' endemic forest birds (*Pacific Science 31:* 109-33).

Effects of Norway rats (*R. norvegicus*) on coastal vegetation in New Zealand have been studied jointly with Wildlife Service and Entomology Division. Although the primary aim of this project is to develop methods of eliminating Norway rats from small islands, a great deal of preliminary botanical and other work has been carried out in the experimental area (Noises Islands, Hauraki Gulf) so that the most efficient eradication programme can be planned. Detailed maps of the islands' vegetation and soils have been prepared together with studies of the seasonal availability of parts of plants that may be eaten by rats.

Dr Atkinson has also summarised the known effects of the three rats in New Zealand (*R. exulans, R. norvegicus, R. rattus*) on island vertebrates, particularly birds (*Dept. Lands and Survey Information Series 4:* 7-30). Attention is drawn to the numbers of rat-free islands (ca. 90) still remaining in the New Zealand region and the need for rodent protection to be continued for many islands.

No major control of opossums has occurred on Kapiti Island since 1969. Monitoring of the vegetation for opossum damage has continued throughout the 1975-78 period. The level of damage to tawa and kohekohe in the southern part of the island has increased slowly with losses of some tawa trees, although regeneration is sufficient to replace losses in most places. In the central part of the island a small but measurable increase in damage to northern rata has been recorded. Juveniles of northern rata are rare on the island so that, if left

uncontrolled indefinitely, opossums could cause an irreversible decline in the northern rata population. A control programme for opossums in this part of the island is being planned for 1980.

To assist with information on the effects of domestic feral animals in National Parks, or the effects of their removal, Botany Division maintains permanent plots in Nelson Lakes and Westland National Parks and in the scenic reserve on Arapawa Island.

Dr Given and Mr C. D. Meurck (University of Otago) accompanied the 1975/76 Department of Lands and Survey Expedition to Campbell Island. As well as carrying out botanical exploration which resulted in several new records, they noted that the exclusion of sheep from part of the island since 1970 had resulted in a dramatic increase of *Pleurophyllum* and *Stilbocarpa* in the upland herbfields.

The rather unusual growth form of divaricating plants has puzzled botanists since the time of Cockayne, especially as no other country has such a high proportion (ca. 10%) of its woody flora represented by these plants. Following a study of several attributes shared by divaricating plants, particularly their branching angles, their variation in leaf size, the toughness of their stems and their habitats, Mr R. M. Greenwood (Applied Biochemistry Division) and Dr Atkinson have presented the hypothesis that browsing by moas was a major factor contributing to the development of the growth form (*Proc. N.Z. Ecol. Soc. 24:* 21-33).

Vegetation Survey

1. Methods

Most vegetation surveys carried out by Botany Division involve intuitive recognition and qualitative description of plant communities, and reports are usually presented in the traditional narrative style. This flexible approach can be applied equally well where a small area of vegetation has to be described in great detail, or where a large area has to be described in broad terms. Moreover, it can be used to extend, or to place in context, quantitative measurements on vegetation. On the other hand qualitative descriptions of vegetation, if they are to be reliable, demand considerable competence in recognition of plants, knowledge of ecological principles and experience.

If lowland native plant communities are to be adequately reserved in areas of continuing land development, the need for information on the distribution of these communities can exceed the capacity of trained field ecologists to provide it. To overcome this problem, Dr Park and Mr Walls have developed a method of rapid inventory to provide regional coverage of threatened communities. Because this method concentrates on recording the key features of stands, it requires minimal field work, and it can also be used, under supervision, by people trained to recognise only key species. The

information is assembled in a form to allow systematic selection of a regional series of key sites where protection of indigenous plant communities should be a priority.

2. Land Use Studies

During the three year period, the Department of Lands and Survey has carried out land use studies in various districts, in some instances in collaboration with the New Zealand Forest Service. Botany Division scientists have taken part in the King Country, Marlborough, three regions in the Southern Alps (Poerua-Wanganui, Upper Rangitata and Hooker Range—Landsborough), Mackenzie country and briefly, in the South Westland lowlands. Lowland forests of North Auckland are being surveyed using the inventory method described above by students supervised from the University of Auckland, and advised by Dr Park. Following a land use study in Stewart Island, the Department of Lands and Survey engaged Mr H. D. Wilson under contract to carry out a botanical survey and this has involved technical and logistic support from Botany Division.

3. National Parks

This period has seen progress in meeting Botany Division commitments in National Parks. A vegetation map of Tongariro National Park (1:63,360), based on the ecological survey made there during the nineteen-sixties, has been completed and forwarded for final draughting. It is planned to print this map, with an extended legend describing the kinds of vegetation mapped, as a separate publication. A flora of Mt Egmont is also being prepared, and Mrs Bulfin and Dr Galloway have published a list of bryophytes and lichens for Nelson Lakes National Park. A description of the plant communities of Westland National Park has also been published, and a general account of the plant ecology is in press.

4. Biological Survey of Scenic Reserves

Scenic reserves surveys are under way in North Auckland and Southland. Reserve surveys in the Marlborough Sounds commenced in 1975, and other parts of Marlborough will be examined during the next triennial period. The report on the scenic reserves of Otago have been published, and those on the reserves of South Westland are ready for publication. In Wellington land district, a report has been made on the Gordon Park Scenic Reserve, a remnant of kahikatea forest containing the fern *Adiantum diaphanum*.

5. Other Regional Vegetation Surveys

Botany Division has carried out surveys in various other districts, providing information which should assist land planners to take adequate account of biological conservation. The districts are the Taitapu Estate in northwest Nelson (with the permission of the

owners and in cooperation with Ecology Division), where there is an intact sequence from tidal vegetation to forest dominated by kahikatea and pukatea; the western Paparoas (in cooperation with Mr J. A. Bartle, of the National Museum) where the Minister of Forests has accepted the resulting proposal for a Pororari Ecological Reserve, which, in combination with the Punakaiki Scenic Reserves, provides an intact sequence of diverse forest types and landforms from the coast to the crest of the Paparoa Range; and in the largely undisturbed Paringa-Moeraki, Haast-Arawhata, and Cascade districts of South Westland. In the last two areas, the field parties included, at various times, members of Ecology Division, Soil Bureau, Geological Survey, and a representative from the Commission for the Environment.

6. Local Surveys

Botany Division has been involved in numerous surveys covering smaller areas, chiefly proposed reserves or additions to existing scenic reserves, and areas involved in environmental impact reports and assessments. The following regional lists are by no means complete:
Auckland district: Auckland volcanic cones; Piha Beach; Tiritiri, Motutapu, Motukorea and Motuihe Islands; Punahaere Creek; Mt William Scenic Reserve; Maunganui Bluff, Great Mercury Island; Smiths Bush (Takapuna); Aorangi Island.
Gisborne district: Maungataniwha Scientific Reserve and proposed reserve (Huiarau Range); Grays Bush Domain which contains a valuable remnant of kahikatea-puriri forest.
Wellington district: an interesting patch of bush in the Mangatipona valley was inspected as a prospective conservation covenant. Although this 30 ha remnant is extensively modified, it is rich in species. As part of the Pauatahanui Environmental Programme, a vegetation survey has been made of the catchment of the Pauatahanui Inlet (108 sq km) with particular attention given to remnants of woody vegetation. An account of the results has been completed and will be published in the forthcoming booklet that brings together results from all the recent Pauatahanui studies.
Marlborough: a remnant of kahikatea-tawa-kohekohe forest at Four Fathom Bay (Pelorus Sound); Tawhitinua and Tarakaiapa Islands (Tennyson Inlet); islands in Croisilles Harbour; a recreation area at Momorangi Bay (Queen Charlotte Sound); Victoria Domain (near Picton); an area of kahikatea-tawa-titoki forest on the north bank of the Wairau River; Cloudy Bay coastline, including the Vernon Lagoons.

Nelson: a large area with reserve potential in the Maruia valley; Matiri Range, an area that yielded over 400 species of higher plants, several previously unknown.

Westland: surveys in North Westland in relation to reserves proposed under the Beech Utilisation Scheme; proposed reserve on limestone on Kowhitirangi Hill that includes several species at their southern limits on the West Coast; unoccupied crown land adjacent to Mahinapua Scenic Reserve.

Canterbury: Lake Sumner district; coastal reserves; Quail Island (Lyttelton Harbour); Castle Hill (resulting in a reserve to protect an isolated stand of bog pine and the only known natural occurrence of *Hebe armstrongii*); stand of miro at Port Levy; islands in Lake Benmore; Hope River; Mt Nimrod; Coal Hill.

Otago; south branch of the Waikouaiti River (for Regional Planning Authority); Puerua River, Sandymont and Sandfly Bay Wildlife Refuges; forest remnants on Otago Peninsula; False Islet (SE Otago); flora and vegetation in lower Waitaki and upper Clutha valleys in relation to irrigation and hydroelectric schemes in the latter, with a special view towards selecting reserves for semi-arid grasslands, which are poorly represented in the national reserve system.

Southland: Waitutu State Forest, Dome Mire near Te Anau (to assist with delineating and managing a reserve); Mt George in Fiordland; Muttonbird Islands (in relation to saddleback habitat); Little Solander Island.

7. Environmental Impact

In addition to meeting requests for reports on existing vegetation, Botany Division has also provided comment on possible biological effects of various developments, for example, a proposed road to the Mt Robert Ski Field (Nelson Lakes National Park); the Lake Kaniere hydroelectric proposal being investigated by the West Coast Power Board; a drainage channel adjacent to the Nikau Scenic Reserve near Punakaiki; and a proposal to establish an airstrip on Mt Tarawera plateau, with reference to the need to recognise the unique and biologically valuable nature of the montane gravel fields there. Botany Division has also stressed that proposed farming development on the higher rainfall part of the Aorere (Nelson) pakihis, an exhumed Eocene peneplain, would destroy vegetation of great natural interest for questionable economic benefit.

Exotic forestry in the Marlborough Sounds is largely at the expense of scrub of native and introduced species. Scientists of the Division have pointed out that this scrub represents a stage in the succession back to native forest, and also has scenic and conservation potential. The growth rates of some of the species is rapid; kanuka, for 'instance, develops into a tall woodland within 40-50 years.

Tree deaths around Lake Te Anau as a result of holding the lake at an artifically high level continue to be monitored, as described in the previous Triennial Report. Dunedin substation also has con-

tinuing involvement with Awarua Bog (the subject of earlier reserve recommendations), in relation to damage by fire and drainage and the likely effects of peat mining proposals.

8. Surveys of Special Communities and Habitats

(a) Geothermal vegetation

Studies of plants on geothermal sites were started by Dr Given in 1976 at the request of the Wairakei Tourist Park Board. Initially the aim was to identify sites of scientific interest, and especially those which had populations of ferns and fern allies usually found to the north of New Zealand in the tropics, with New Zealand mainland distributions restricted to geothermal sites and a few lowland localities. Studies of the vegetation have continued to the present at Wairakei and attention has chiefly focussed on about 35 ha of steaming ground adjacent to the Karapiti fumarole. This has now been mapped in detail and five zones of vegetation delimited, which are correlated with ground temperatures, the depth of the 50°C isotherm being particularly critical. The Karapiti work has been written up for publication.

At the request of the Department of Lands and Survey, surveys have been extended to other sites in an attempt to evaluate the botanical significance of all geothermal sites in New Zealand (see list of unpublished reports). Preliminary rankings have been carried out for a number of sites.

An overall aim is to establish a network of representative geothermal sites encompassing the whole range of variation of vegetation types characterising heated soils, hot springs, fumaroles and solfataras. This requires an assessment both of the vegetation at each site and the component species; some sites are notable for the presence of threatened or highly disjunct species which are able to survive because of localised factors such as highly mineralised soils and mild microclimate.

(b) Tall Lowland Forest

Tall forests on lowland plains and terraces throughout Nelson and Marlborough were used as the testing ground for the inventory method, and the results of this survey of over 900 remnants have been published. A similar inventory of forest remnants on the Moutere Gravels of Nelson has nearly been completed.

(c) Vegetation of coal measures

The vegetation of the Denniston and Stockton coal plateaux is remarkably interesting and diverse, but little of it is included in existing reserves. Dr Park has extended the work on this area that he and Dr Given began for the Site Assessment Report for the proposed Buller thermal power station. Though much of the vegetation has been burnt, most is intact and includes the stunted

forest, scrub and tussock land communities characteristic of extremely infertile, humid uplands. Some of the species are practically confined to these habitats, and some are otherwise alpine. One, *Gleichenia flabellata*, has a very restricted distribution in New Zealand.

(d) Lake edge vegetation

Dr Johnson has extended the survey of the vegetation and flora of lakes and lake shores, originally begun in relation to the Manapouri power scheme, to other lakes in Fiordland, Otago, Canterbury and Westland. This has greatly added to knowledge of these rather neglected plants, both native and introduced, and at least one new species, belonging to an undescribed cruciferous genus, has been added to the flora as a result. A survey of aquatic weeds in the upper reaches of the Clutha River has also been carried out.

(e) Sand dune and coastal vegetation

Dr Johnson has written a report on the sand dune vegetation of Fiordland and adjoining coasts to as far as Cascade Point and Te Waewae Bay. The work began as a result of applications to prospect beach sands, and has a further purpose in the need to assess the distribution of adventive weeds on these dunes, which are among the least modified in New Zealand.

(f) Salt pan vegetation in Central Otago

In Central Otago there are areas where the concentration of salt in the soil is high enough to promote a distinctive vegetation, including several endemic species. These communities are very much threatened by irrigation and other farming developments, and the Dunedin Substation has been making an inventory of them and drawing up reserve proposals.

9. Distribution of Species

An incidental gain from vegetation survey is increasing knowledge of the distribution of plants through New Zealand and over the years numerous lists of species covering various districts have been compiled.

Dr Given has been specially studying rare and endangered plants in New Zealand, which are believed to number about 250 species. Of these, approximately 40% have been treated in detail in a loose-leaf register of threatened plants ("Threatened Plants of New Zealand", David R. Given, 1976-). Individual site-species records are card-indexed at Botany Division and reports are being maintained on the basis of this index. Publicity of this scheme has resulted in an increasing number of records and comments being received from both amateurs and professionals outside the Division.

In 1978, Dr Given was invited to join the Threatened Plants Committee of IUCN, a specialist body coordinating international

work on threatened plants as well as encouraging conservation efforts. More recently, a Threatened Plants Group has been formed with members from different parts of the country. This will assist with identification of local problems, monitoring of individual species and compilation of reports on both regions and taxa. Members of the group (as at May 1979) are: R. O. Gardner and J. Bartlett (Auckland), J. L. Nicholls (Rotorua), G. C. Kelly (Wellington), D. R. Given (Christchurch), and P. N. Johnson (Dunedin).

In January 1979, two symposia on rare and endangered species were held as part of ANZAAS. These have now been published by Nature Conservation Council ("A Vanishing Heritage: the problem of endangered species and their habitats". Nature Conservation Council, Wellington 1979) and provide a background for an enquiry being held by the Council into the conservation and status of threatened species and their habitats. Botany Division is providing resource material and comments, where appropriate, for this. The symposium proceedings provide an up to date account of the status of threatened plants in New Zealand. It is estimated that within the general category of threatened, 4% are extinct, 25% endangered (in danger of extinction if causal factors continue to operate, or requiring intensive management), 16% vulnerable (likely to move into endangered category if depletion continues), 45% rare, and 10% indeterminate. Key areas are North Auckland and South Auckland, Wellington, Nelson, Marlborough and the Chatham Islands. In North Auckland, in particular, land development is putting endangered species under considerable pressure especially in coastal sites, wetlands and scrublands. The future of riparian species is also a matter for concern. Aerial spraying for weeds along rivers has depleted plants such as the endemic brooms in Marlborough and *Helichrysum dimorphum* in Canterbury. Exports of live plants for trade are being monitored and a permit is now required for any species listed as threatened; Botany Division is collaborating with the Ministry of Agriculture and Fisheries in implementing this scheme.

UNPUBLISHED REPORTS RELATING TO ECOLOGY AND CONSERVATION

(Dr A. D. Thomson)

Allen, R. B. 1976: Botanical Survey of Scenic and Allied Reserves in Otago. Interim Report. 10 pp.

Allen, R. B. 1976: Development: Seacliff/Orokonui Farm Settlement. Botanical Report. 7 pp.

Allen, R. B. 1976: Waipori Station. Reserve Proposals. 18 pp.

Allen, R. B. 1977: A Comparison of Autumn- and Spring-burnt Sites in Snow Tussock Grassland, Flagstaff Hill, Dunedin. 4 pp.

Allen, R. B. 1977: Botanical Report. Native Vegetation, Wyllies Crossing. 8 pp.
Allen, R. B. 1977: Report on Botanical Survey of Native Vegetation Adjacent to Chingford Park, Dunedin. 6 pp.
Allen, R. B. 1977: Report on Botanical Survey, Taieri Mouth. 16 pp.
Allen, R. B. 1977: Silver Beech Remnants on Flagstaff Hill, Dunedin. 6 pp.
Allen, R. B.; Lee, W. G. 1977: Botanical Report. Section 38 and Surroundings, Block 1, Dunedin and East Taieri Survey District. 10 pp.
Allen, R. B.; Johnson, P. N. 1978: Comment on Management Plan and Environmental Assessment for Maungatua Forest. 4 pp.
Allen, R. B.; Lee, W. G. 1978: Botanical Report, Coastal Reserves Survey, Clutha County. 7 pp.
Allen, R. B.; Lee, W. G. 1978: Botanical Report. Native Vegetation, Akatore, East Otago. 11 pp.
Allen, R. B.; Lee, W. G. 1978: Comment on Dart State Forest Future Management Options.
Allen, R. B.; Lee, W. G.; Mark, A. F. 1978: Submission on the Preservation of Native Forest on Mount Cargill, Dunedin. 4 pp.
Atkinson, I. A. E. 1976: Report on Delaney Catchment, North-east of Taita Experimental Station. 2 pp.
Taylor, R. H.; Atkinson, I. A. E. 1976: Review of Current Research on Rodents in New Zealand. 8 pp.
Atkinson, I. A. E. 1977: Comments on Management Plan for Kaweka State Forest Park. 2 pp.
Atkinson, I. A. E. 1977: Comments on Management Plan for Ruahine State Forest Park. 4 pp.
Atkinson, I. A. E. 1977: *Pinus contorta* in North Island Mountains. 11 pp.
Atkinson, I. A. E. 1977: Removal of Wekas from Codfish Island. 11 pp.
Atkinson, I. A. E. 1977: Report on Factors Affecting the Preservation of Rock Carvings at Atiamuri and Kaingaroa. 6 pp.
Atkinson, I. A. E. 1977: Some Details of the Mapping Method Used for Tongariro National Park. 9 pp.
Atkinson, I. A. E. 1977: Vegetation Surveillance for Kapiti Opossum Study. August 1975-February 1977. 6 pp.
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PALYNOLOGY AND QUATERNARY BOTANY

(Dr N. T. Moar)

Although the main thrust of our work during the last three years has been directed towards Quaternary studies in the North and South Islands increasing attention has been devoted to pollen morphology. Late in 1978 a pollen analytical survey of New Zealand honeys was initiated as a contribution to quality control for the small, but expanding export market. This survey involves recognition of pollen types unfamiliar to a Quaternary pollen analyst resulting in additions to our reference slide collection as an aid to their identification.

The honey survey draws attention to pollination problems and to the feeding habits of insects and other animals. It was therefore with considerable interest that we examined the crop and gut contents of syrphid flies (hover flies) and the guano, gut contents and fur of the native short-tailed bat for pollen. It is clear from the variety of pollen types recorded that both the flies and the bats play an important role in transferring pollen from one flower to another.

Important Quaternary studies in central North Island have been

undertaken by Mr M. S. McGlone while on study leave at the Botany Department, University of Canterbury, during 1975-1978. This work contributes much to our understanding of vegetation and climate history during the Otiran (last glacial) and Aranuian (post-glacial) and allows us to see New Zealand problems in a broader perspective. More recently preliminary examination of organic layers within cover beds of marine benches along the Taranaki and Wanganui coasts offers the possibility of extending vegetation history back in time for some 300,000 years.

The interest in past environments has received added impetus from the accumulating evidence of fires extending back in time for thousands of years. There is no doubt that fire has had a marked impact upon the vegetation in New Zealand during the last glacial and the post-glacial although there is no evidence to suggest that the devastation attributed to Polynesian and European times occurred earlier. The need to date Quaternary events is well understood, but it is also important to re-examine assumptions relating to dating techniques. The work of Dr K. M. Goh, Lincoln College, and of Dr B. P. J. Molloy in drawing attention to contamination by humins as a source of error in radiocarbon dating of charcoal is an important contribution to this aspect of Quaternary work in New Zealand.

The results achieved depend upon the enthusiasm and skill of everyone involved, including technical staff who are always on the alert to improve methods in pollen studies, including electron micrography, the preparation of pollen diagrams and the production of photomicrographs. During the last three years hundreds of samples have been processed, more than twenty pollen diagrams, most of them published or about to be published, have been drawn, and many pollen photographs, including SEM and some TEM studies have been handled for the pollen atlas and other staff projects.

1. Pollen Morphology (N. T. Moar)

Work on the pollen atlas of native dicotyledons is well advanced and about 60 families have been dealt with. The atlas is to be illustrated with bright field photomicrographs, scanning electron micrographs and some transmission electron micrographs. This work has high-lighted the need constantly to curate our reference collection and requests for help in various ways have drawn attention to the need for concise up-to-date descriptions of fern spores, the pollen of honey plants and of hay-fever plants. We have therefore not only improved our collection of native pollen types but also prepared new slides of the spores of all native ferns, storing the residues in silicone oil, and have begun to improve our holdings of introduced plants. It is our aim eventually to produce a series of pollen atlases which will meet the steady demand for our help with pollen identifications.

Our collection of pollen photographs has continued to grow and especial attention has been directed towards increasing our studies by scanning electron microscopy.

2. Honey (N. T. Moar)

Late in 1978 we began a pollen analytical study of New Zealand honeys. This has arisen because some importing countries demand microscopical examination of honey, including pollen analysis, and may reject shipments if the description supplied by the exporter does not match their analysis. This work is being carried out in close liaison with officers of the Ministry of Agriculture and Fisheries who supply samples from various districts throughout the country.

As in most pollen analytical work, problems of over-representation or under-representation of certain pollen types have to be considered and it is with these problems in mind that we hope to develop standards for the New Zealand product. Because our honey is usually exported to Europe we are taking into account European practice, where pollen analysis of honey has been routine for many years, but realising that local differences must be recognised when considering standards.

3. Quaternary Research

Work relating to the history of vegetation and climate since the last interglacial (Oturi) are in progress in the North and South Islands.

(a) Central North Island (M. S. McGlone)

During the last 3 years an intensive study of peat and lignite sections of post-glacial and last glacial age in the central North Island has been made. The impetus for this work has been the continuing investigations by geologists and tephrochronologists on the stratigraphy and history of the numerous ash shower deposits originating from Egmont and the Volcanic Plateau. The investigations have provided an unrivalled base for the understanding of the history of the vegetation. Besides tephra stratigraphy there has been renewed interest in the marine-cut benches prominent along the Taranaki and Wanganui coastlines. An Australian geographer, Dr Brad Pillans, has made progress in the dating of the organic deposits found in the cover beds of these marine benches and as these deposits can also be used in palynological studies there is a potential in this area for vegetation history going back at least 300,000 years. Further, these marine benches can be correlated with the dated global sea-level curve and so any pollen analytical data can be related to records in other parts of the world. The sequences relating to the last glaciation have been fully analysed and now work on the older deposits is underway.

New pollen diagrams from Taranaki, Rotorua, and Hawkes Bay

have confirmed the trends of Aranuian (post-glacial) vegetation history derived from earlier work elsewhere, and on the Volcanic Plateau. Forest was widespread from 14,000 years ago on, although its arrival was delayed in some places until 12,000 years ago or later. After 10,000 years ago there was a long period of comparatively mild climate which was terminated about 5000 years ago by the first of a series of climatic deteriorations. The history of individual species that were affected by the climatic deteriorations has been confirmed by the newer work. In particular, the history of *Ascarina lucida* and *Dodonaea viscosa* (both plants that were common in the mid Aranuian and have been restricted since 5000 years ago) has been amplified and extended. There are further additions to the list of species that have shown marked extensions or contraction in range in the late Aranuian. *Knightia excelsa* has become common only in the last 3-2 thousand years, and *Dacrydium colensoi* is known to have flourished briefly in lowland Taranaki, an area now outside its natural range, from about 5000 to 2000 years ago.

Most of the work done in the central North Island in recent years concerns the older deposits of Otiran age (Last Glaciation). The Otiran is proving to be a botanically complex period, with diverse plant groupings at various times and places. There have been at least 2 main interstadial (warm periods) and numerous minor ones. The earliest interstadial may have occurred at about 60,000 years ago, and was characterised by widespread podocarp forest. Uncertainties of correlation prevent a detailed understanding of this period and there is a possibility that more than one early Otiran interstadial is involved. Nevertheless, it can be said that there was an early Otiran period when most of the North Island had a forest cover of some description. There was another, later interstadial which may have lasted from around 40,000 to 26,000 years ago. During this period beech forests were widespread (in some favoured regions such as Gisborne there was dense podocarp forest), while in high altitude regions scrubland tended to replace grassland. After about 26,000 years ago scrub and grassland spread again at the expense of forest.

Despite these relatively mild interstadials nearly all of the central North Island had grassland or scrubland for most of the Otiran during its peak from 20,000 to 14,000 years ago. There is no direct evidence of forest.

Investigation of Southland and Otago sites has been neglected while the North Island work was continuing. However, some preliminary work has been done in the Longwood Range, western Southland. Although the sites have not yet been dated, and complete analyses are not yet available, the results so far are interesting. It seems that the first post-glacial forest in the Longwoods region was a matai-white pine association which was later replaced, about 5000 years ago by correlation with other sites, by rimu and silver beech. Similar results

are already known for Dunedin and Catlins Range areas. This pattern could be the result of a shift in weather patterns over the last 5000 years which has led to southerly and south-easterly winds becoming more common in coastal areas. An expected result of this pattern would be colder conditions, favouring silver beech, and more rain, favouring both rimu and silver beech.

Some North Island sites are of archeological significance, particularly in relation to forest burning by the early Polynesians. I have co-operated with a team of Auckland archeologists in their investigation of a site at Kohika in coastal Bay of Plenty where there is an ancient Maori occupation site on a sand hill in the middle of swamp near the Tarawera River. Pollen analysis of a peat column close to the pa site has shown that deforestation of the lowland Bay of Plenty took place extremely rapidly. No dates are available for this site yet but, from accumulation rates and an uncertain age of 900 years for the Kaharoa Ash it appears that deforestation began just before the deposition of the Kaharoa Ash and was completed within a hundred years. The date of deforestation has a bearing on the time of arrival of the earliest Polynesians, and confirms the results from Lake Poukawa in the Hawkes Bay, which indicated that deforestation took place about 1000 years ago.

(b) Central South Island (N. T. Moar)

Investigation of the last interglacial, last glacial and post-glacial sites near Westport mentioned in the last report has been concluded and the results submitted for publication in the *New Zealand Journal of Botany*. Of particular interest is the record of a long grassland phase which followed a shrubland of *Phyllocladus* and *Dacrydium bidwillii* about 25,000 years ago and which persisted until the expansion of post-glacial podocarp forest some 12,000 years ago. Although the transition to grassland may have been influenced by a return to glacial cold it is unlikely that its persistence was controlled by a uniformly rigorous climate for some 13,000 years. Evidence that *Nothofagus* forest occurred in the Hokitika area during the same period suggests marked differences in regional climate, and the history of glacial advance and retreat on both sides of the Main Divide provides a record of fluctuating climate. It is possible that, following the cold climate leading to glacial expansion and the establishment of grassland, climatic shifts occurred too rapidly for the vegetation to react in any obvious way until the steady climatic improvement of the post-glacial. There are now a number of sites from both sides of the Main Divide ranging in age from about 12,000 years–22,000 years from which an open grassland vegetation is recorded and although many of these are based on only one or a few samples, they support the concept of a long continued grassland phase.

In addition to last interglacial sites from the Westport areas, others

between Westport and Greymouth have been examined and pollen analysis of another near Hari Hari is in progress. Of particular interest are records of *Nestegis* (Oleaceae) pollen which are found in low frequencies in most sites. This tree does not occur south of the Nelson area in western districts and besides providing evidence that it was formerly much more widely distributed the records offer a means of separating interglacial from post-glacial sediments. So far there is no complete record of interglacial vegetation development from central South Island although there is hope that the Hari Hari site may improve this situation.

Other work recently initiated is a study of the effects of Polynesian fires, in palynological terms, upon vegetation in Canterbury. Some information, already available, has been derived as the result of other studies. A site at Porters Pass was examined to determine the effects of fire upon the vegetation. The results show that following the destruction of *Nothofagus* forest, *Bulbinella* and *Anisotome/Aciphylla* spread more rapidly than the grasses and that *Nothofagus* recovered slightly before it was affected by European settlement which is recorded in the pollen diagram by *Pinus, Salix* and *Plantago lanceolata* pollen. It is hoped to study other sites during the next few years.

(c) Sub-fossil charcoal (B. P. J. Molloy)

Work has continued on the recovery, identification and radiocarbon dating of charcoals buried in a variety of deposits, mainly in eastern South Island. The results to date provide additional evidence of man-made and natural fires in late glacial and post-glacial times. As an example, the fire history of the Waimakariri catchment has been reviewed (*in* "Cass: history and science in the Cass district, Canterbury, New Zealand", 157-70, 1977).

Studies of charcoal properties jointly with Dr K. M. Goh, Lincoln College, have shown that older charcoals can be heavily contaminated with humic substances, thereby leading to erroneous radiocarbon dates (*Quaternary Research 7:* 117-96, 1977). Similarly a study of charcoals of wider age range showed that contamination by humic substances is widespread. These contaminants can be removed by alkali-pyrophosphate treatment, a technique we suggest should be routinely adopted (*New Zealand Journal of Science 22:* 39-47, 1979).

SEED

(Mrs M. J. A. Bulfin)

This period has seen an expansion in several aspects of seed work, especially in that dealing with seed germination, in work towards a seed atlas of New Zealand species, and in studies of percentage seed set in some fruits and on the capitulum of some Compositae.

1. Seed germination and duration of viability

Effects of light, temperature and age of seed on the germination of selected species have been studied. Other factors affecting germination such as humidity and light quality have not, at this stage, been considered, but as so little is known of the germination requirements or the biology of seeds of New Zealand species the basic information which is being accumulated will provide a useful background for more detailed investigations. With this in mind simple tests for germination have been carried out for a large number of species of many genera. For other genera e.g. *Aciphylla, Astelia, Gentiana, Hebe* and *Ranunculus* seeds of several species of each have been examined and for two families, Lobeliaceae and Myrtaceae extensive tests have been made for most species.

In some seeds e.g. in *Gentiana* spp. and *Ranunculus* spp. the embryo, at time of apparent maturation of the seed, is small and under-developed and a period of after-ripening is necessary before germination can take place. Stratification and/or alternation of temperature can hasten the development of the embryos in these seeds to reduce the period of apparent dormancy. For these, and other species, treatments with chemicals such as gibberellin would be of interest. At the other extreme seeds of some species have fully developed embryos at the time of seed-ripening and need to germinate immediately for survival, e.g. Loranthaceae, *Griselinia* etc. In many Compositae seed germination is almost entirely dependent on the availability of moisture. Seeds of *Pachystegia* for example, will germinate at temperatures ranging from 0°C to at least 30°C when moistened. Seeds of other species will only respond to treatment at a particular temperature e.g. *Drosera arcturi.*

The time that a seed can remain viable is of great ecological importance, therefore once uniform conditions are established and when sufficient stocks are available, seeds, stored under uniform conditions at room temperature, are tested at three monthly intervals to determine the duration of viability. It has been established that seeds of most species of *Hebe* will only remain viable for periods of up to two years, whilst seeds of *Leptospermum* species under trial are still germinating after storage for over six years. Duration of viability has been investigated for a good many *Hebe* species, for most representatives of the family Myrtaceae in New Zealand, in all indigenous members of the Lobeliaceae and in some coastal plants. Results of work with *Hebe* were published in the *Proceedings of the New Zealand Ecological Society 23:* preliminary trials with *Pachystegia* (with B. P. J. Molloy) in the *Canterbury Botanical Society Journal: Drosera arcturi* in the *Australian Seed Science Newsletter 2:* A paper was given at the International Symposium on Reproduction in Flowering plants held in Christchurch, February 1979 on "Seed set, germination and viability in New Zealand Myrtaceae".

Some investigatory work on the germination requirements of seeds of species required for replanting projects has been done on behalf of the Ministry of Works and Department of Lands and Survey for Te Anau (Mr T. Meadows); for the Department of Lands and Survey for replanting reserves in the vicinity of Christchurch; for Riccarton Bush (Dr B. P. J. Molloy) and for Tussock Grasslands Institute.

Preliminary experiments on the germination requirements of the naturalised species *Cytisus scoparius* and *Vittadinia triloba* have been conducted by Dr P. A. Williams.

2. Endangered Plants

Seeds of three species listed by Dr D. R. Given in his list of rare and endangered plants of the New Zealand botanical region have been given special attention. Two of these, *Ranunculus paucifolius* and *Pittosporum obcordatum* required complex treatment before germination was achieved. Dr L. McCaskill has collected seeds of *R. paucifolius* over three seasons and seedlings from earlier collections have already been planted in Castle Hill Reserve. With a good collection of seeds made by Dr McCaskill last season we are attempting to confirm earlier successful experiments. Seedlings from a seed collection of *P. obcordatum* made by Mr A. P. Druce are also being grown on for replanting in a reserved area. Seeds of *Gnaphalium nitidulum* germinated readily when fresh and plants are being grown on for study.

The possibility of a seed bank to store seeds of particularly endangered species may need to be considered and for this reason details of storage requirements and duration of viability of particular species is vital.

3. Seed set and development

From early studies with seeds of capsular Myrtaceae it became clear that large numbers of ovules in each capsule were unfertilised and that some selection of seeds was necessary for germination tests. In consequence counts have been made of fertilised and empty seeds per capsule from ten capsules per plant of most New Zealand species of the family, and also, where possible, from different populations. These show in general a low percentage seed set but with some geographic variation. Some information from this study was presented in the paper mentioned above.

Following reports from gardeners here and overseas that poor germination resulted from seeds of garden grown plants of *Pachystegia*, some preliminary investigations were made into seed set in garden plants and in some natural populations (Simpson and Molloy, 1978). This showed that in solitary garden plants seed set was nil or very low. The project has been extended to study seed set and the

percentage germination of filled seeds in a number of lowland natural populations. Similar studies have been initiated with *Celmisia* and will be continued as seeds become available.

4. Seed Atlas

The identification of seeds for other research workers, government departments, students, trade firms, veterinarians etc. is a continuing activity (see Servicing). To facilitate this a start has been made towards an atlas of seeds of New Zealand species. Mr C. J. Miles has made excellent photographs of pyrenes of almost all indigenous species of *Coprosma*, (following the updated arrangement of A. P. Druce). He has also photographed seeds of the family Myrtaceae as well as seeds of many individual species from various genera. Utricles and nuts of Cyperaceae have recently been prepared for photography.

The scanning electron microscope has been used to photograph distinctive surface patterns on the small seeds of New Zealand representatives of the Lobeliaceae and for details of nuts of the Boraginaceae as well as for small seeds of other species. It is anticipated that it will be used again for other small seeds.

Illustrations of seeds by K. R. West and scanning electron microscope photographs of surface patterns of seeds of New Zealand *Epilobium* spp. are published in "The genus *Epilobium* in Australasia", Raven and Raven.

5. Talks

Talks about aspects of work with seeds have been given to the New Zealand Ecological Society, International Symposium on Flowering Plants, Wellington Botanical Society, Canterbury Botanical Society, and Canterbury Alpine Garden Society.

To study a seed is to study the whole plant in miniature and although information gained may not be immediately relevant to any particular project it leads to a better understanding of the plant in its entirety.

MORPHOLOGY AND ANATOMY

1. Chromosome atlas (Mr E. J. Beuzenberg)

After his retirement in 1974, the late Dr J. B. Hair completed his chromosome survey of the New Zealand species of *Epilobium* (Onagraceae), and before her resignation in 1974, Mrs B. E. Groves completed her work on *Gnaphalium* (Compositae). The results were published in 1977.

During the two decades of work on the chromosome atlas, chromosome numbers were determined for a miscellany of plants.

Since the survey remained incomplete for many genera and completion is not contemplated, all unpublished numbers are now being assembled for publication.

2. Juvenility and heteroblastic development (Mr E. J. Beuzenberg)

Observations on plants exhibiting heteroblastic development are continuing. These plants include *Aristotelia, Carpodetus, Elaeocarpus, Paratrophis, Parsonsia, Pseudopanax* and *Pennantia.* Processes underlying sylleptic branching patterns and anisophylly are being studied.

Bifurcation ratios were determined in seedlings, young trees and adult branches of *Elaeocarpus hookerianus.* The values obtained give indirect support to the suggestion made by Professor P. B. Tomlinson of Harvard University that the bifurcation ratio of habit-heteroblastic trees may change during the transition from the juvenile to the adult growth phase. The wide range of mean bifurcation ratios observed in a juvenile population of this species is related to the varying degrees of plagiotropic or orthotropic growth within individual plants, and is reflected in their more sympodial or more monopodial architectures. As the trees mature, the diverse ratios will presumably settle down to a value characteristic for the adult form of the species.

3. Wood anatomy (Mr R. N. Patel)

(a) Systematic study of the wood anatomy of the indigenous dicotyledonous shrubs and trees has continued. Most anatomical features especially those with diagnostic value have been recorded for 170 species. Experimental work on Loranthaceae, Piperaceae, Tiliaceae and Papilionaceae (*Sophora*) is nearing completion. About 200 species are represented in the collection of reference slides.

(b) Work on the wood anatomy of Oleaceae, Icacinaceae and Moraceae was completed in collaboration with Mrs A. Bowles of the Forest Research Institute, Rotorua. Segregation of New Zealand representatives (*Nestegis* spp.) of the Oleaceae from *Olea* on the basis of external morphological features is supported by anatomical evidence. Several major anatomical features distinguish *Nestegis* from *Olea.*

(c) About 300 wood samples were identified for various inquirers throughout New Zealand.

4. Bark anatomy (Mr R. N. Patel and Miss J. E. Shand)

Recent interest in the utilisation of the South Island beech forests prompted the study of bark anatomy of red, silver, mountain and hard beech. Cork and parenchymatous tissue contain large amounts of polyphenolic compounds. Fibrous tissue which represents 31% to 53% of bark volume consists of elongated thick-walled fibres, and short deformed thick-walled sclereids. Average fibre length of 0.91 mm is slightly shorter than that of fibres of hardwoods used for pulping.

Presence of sclereids and abundant polyphenols could present problems in pulping of wood chips containing bark. Anatomical features of beech bark can be of additional value in the identification of species. For example, fibrous bundles as seen in transverse section are narrower radially in silver beech than in red beech.

5. Vernation in *Nothofagus* (Dr M. N. Philipson)

The mode of folding of the leaf within the bud has long been an important character in the subgeneric classification of *Nothofagus,* but the presence of revolute vernation in the genus has been overlooked. As it was found to occur in three out of the four species a survey of vernation throughout the genus has been carried out with Emeritus Professor W. R. Philipson and its implications in the subdivision of the genus considered (paper in press).

6. Embryology (Dr M. N. Philipson)

Studies on reproductive processes in the grass genus *Cortaderia* have continued with the elucidation of the mechanism of apomixis in *C. jubata.* In this high polyploid ($2n = 108$) the megaspore mother cell, or its meiotic derivatives, degenerate early, and the place of the normal embryo sac is taken by one or more unreduced somatic embryo sacs of nucellar origin. Although 2 or 3 advanced embryo sacs are formed in many ovules, normally only one will develop an embryo. Somatic embryo sacs in *C. jubata* usually contain 6 nuclei—2 antipodals 2 polar nuclei, 1 synergrid and 1 egg—but sacs with 3-8 nuclei have also been observed.

The most outstanding feature of the embryo sac of *C. jubata* is the projection of an haustorium from the synergid. This finger-like extension penetrates the micropyle before turning to one side between the outer integument and the ovary wall. If the micropyle is already occupied, an haustorium from a second embryo sac may penetrate the integuments laterally to reach the space between ovule and ovary wall. It has been found that haustorial synergids are not confined to the apomictic species of *Cortaderia.* Their presence among the sexual spp. suggests that this character may prove to be of systematic importance. In addition, it has been found that *Lamprothyrsus peruvianus* may develop similar synergid haustoria, a character which is extremely rare, being reported in only 4 other genera of the angiosperms.

The process of apomixis in *C. jubata* has proved to be somatic apospory, the condition present in most apomictic grasses. However, as no functional pollen is produced, and in fact embryos are already forming as the panicle begins to emerge from the enclosing sheath, apomixis is also obligatory and seed development non-pseudogamous. In these studies, *C. rudiuscula,* another apomict of Section *Cortaderia,* has proved to reproduce by somatic apospory and non-pseudogamy. The combination of these two characters is apparently unique among

apomictic grasses. This association of characters has now been extended to include *Lamprothyrsus*, a small genus lacking sexually reproducing forms. As already mentioned, synergid haustoria may be present in this genus and these indicate its systematic proximity to *Cortaderia*. It is hoped that related genera of the tribe Arundineae can be examined for their presence.

7. Transmission electron microscopy (Dr M. N. Philipson)

(a) The process of apomixis and the events leading to seed set in *Cortaderia* and *Lamprothyrsus* are being investigated ultrastructurally. In the apomictic species, *C. jubata*, the degradation of certain nucellar cells associated with the early demise of the megaspore mother cell, has been described. Such degeneration is recognised by separation of the nuclear membranes and the appearance of single-membrane-bound vesicles formed from invaginations of both inner and outer nuclear membranes. Such vesicles lie within the perinuclear space and within dilated cisternae throughout the cell cytoplasm. The haustorial synergid has strongly developed transfer walls and a dense endoplasmic reticulum system parallel to the long axis. These two features together appear to support an interpretation that this organ is highly adapted to the absorption and transport of nutrients back to the embryo sac. Other features of the apomictic embryo sac are under investigation, e.g. the structure of the egg and its very close association with the central cell nucleus, and the development within the embryo sac of wall structures formed without phragmoplast.

In comparison of the events in the ovule leading, on the one hand, to normal sexual reproduction and on the other, to the apomictic mode of seed set, ultrastructural investigations are being made on pre-embryo sac development in the ovule in *Cortaderia* (with both sexual and asexual spp.) and *Lamprothyrsus* (asexual). It is already known in a number of flowering plants that the normal sexual megasporocyte develops a thick callose wall during the early stages of meiosis and that this has disappeared by the time the function spore is produced. Callose also surrounds the legitimate magaspore in *Cortaderia* and *Lamprothyrsus* in both sexual and apomictic spp., but in the case of the apomicts this callose wall appears to be subject to enzymatic degradation from outside the cells, with its subsequent decline, and the rise of one or more somatic cells as functional megagametophytes.

(b) Investigations on the ectomycorrhizae of *Nothofagus* have been initiated.

(c) A co-operative study with Applied Biochemistry Division on the location of glucosinolase in aphid muscle is being made. The electron microscope is being used in an attempt to visualise this enzyme already located by histochemical technques. Ultrastructural effects of aphid feeding on cabbage and lucerne are also under study.

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REVIEWS AND NOTICES

Connor, H. E.; Frengley, G. A.; Hayward, J. A.; Heiler, T. D. 1976: Book review. "A Practical Guide to the Preparation of Water Allocation Plans". *Soil and Water 12(6):* 38.

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Sykes, W. R. 1977: Book review. "Trees and Bushes of Europe". *Annual Journal Royal N.Z. Institute of Horticulture No. 5:* 20-1.

Williams, P. A. 1976: Book review. "Vegetation of Mt Cook National Park". *Review* (Journal of the Tussock Grasslands and Mountain Lands Institute) *No. 33:* 15-20.

HONOURS AND AWARDS

Dr H. E. Connor. D.Sc. (Cantuar.), 1978.

Dr E. J. Godley. Fellow *honoris causa*, Linnean Society of London, 1977. Queen's Jubilee Medal, 1977.

Mr A. J. Healy. Associate of Honour, Royal New Zealand Institute of Horticulture, 1977.

Dr P. N. Johnson. Hamilton Memorial Prize, 1977.

Dr M. N. Philipson. Ph.D. (Cantuar.), 1977.

Dr P. Wardle. Fellow of the Royal Society of New Zealand, 1977.

OVERSEAS VISITS

Mr A. E. Esler visited northern Queensland in September 1976.

Dr D. J. Galloway while seconded to the British Museum (Natural History) attended a symposium "Plants and Islands" in Las Palmas in April 1977.

Dr P. J. Garnock-Jones was a member of the Royal Society of New Zealand expedition to Fiji in June and July 1977.

Dr P. N. Johnson accompanied the DSIR expedition to New Caledonia during October and November 1978.

Mr M. S. McGlone attended a symposium on Biological Problems in Quaternary Studies at the Australian National University in February 1978.

Miss B. H. Macmillan visited herbaria in Europe during long-service leave from April to July 1977.

Dr N. T. Moar visited the United Kingdom and Europe in August 1977.

Dr B. P. J. Molloy attended the IUCN Man and Biosphere conference sponsored by UNESCO in Canberra in October 1977.

Dr M. J. Parsons attended the 9th International Seaweed Symposium at Santa Barbara in August 1977.

Dr M. N. Philipson visited the United Kingdom and Europe in November 1976. Dr Philipson attended an international conference on *Rhododendron* classification at the New York Botanical Garden in May 1978 then attended a seminar on ultramicrotomy at the Reichert Training Centre near Innsbruck.

Mr W. R. Sykes visited Raoul Island in November 1976 and February 1978 and was a member of the Royal Society of New Zealand expedition to Tonga in June and July 1977. Mr Sykes also visited Tonga in November 1978.

Dr P. Wardle visited the Australian National University and the Snowy Mountains area in March 1977. Dr Wardle attended a symposium on Biological Problems in Quaternary Studies at the Australian National University in February 1978.

Dr C. J. Webb made a private visit to Australia in February 1978 and took the opportunity to visit herbaria in Sydney and Adelaide.

Mr K. R. West visited the Missouri Botanical Garden, St Louis in May and June 1978 to sketch *Epilobium* species and then visited botanical artists in the United Kingdom.

OVERSEAS VISITORS

Miss Susan Aiken, University of Minnesota; Professor P. C. Baker, California State University; Professor P. R. Bell, University College of London; Mr G. Buelow, Tonga; Dr M. R. Crosby, Missouri Botanical Garden; Dr Mary Kalin-Arroyo, Venezuela; Mr J. Kantor, University of California; Dr Hsuan Keng, University of Singapore; Dr Elizabeth McClintock, California Academy of Sciences; Dr and Mrs M. MacPhail, Tasmania; Dr C. J. Marchant, University of British Columbia Botanical Garden; Dr and Mrs G. M. E. Mayo, University of Adelaide; Mrs Ann Mitchell, University of Adelaide; Dr J. W. Neill, University of British Columbia Botanical Garden;

Dr Barbara S. Parris, University of Cambridge; Dr and Mrs D. Ratkowsky, Division of Mathematics and Statistics, CSIRO, Tasmania; Dr J. A. Taylor, Clemson University, South Carolina; Miss Saundra Taylor, University of Indiana; Professor P. B. Tomlinson, Harvard University; Miss Jocelyn E. P. Townrow, Hobart; Mrs Kalesi Vakaloloma, Fiji; Dr N. M. Wace, Australian National University; Miss A. Warren, Vancouver; Mr J. B. Williams, University of New England; Dr Elise M. Wollaston, University of Adelaide; Professor H. B. S. Womersley, University of Adelaide; Professor and Mrs R. D. Wood, Kingston, Rhode Island.

COMMITTEES AND APPOINTMENTS

Dr I. A. E. Atkinson. Fauna Protection Advisory Council; Kapiti-Mana Islands Advisory Committee.

Mrs M. J. A. Bulfin. Farewell Spit Scientific Advisory Committee; New Zealand Ecological Society Council; Canterbury Alpine Gardens Society Council.

Dr H. E. Connor. North Canterbury Catchment Board (Chairman Water Committee); Mount Cook National Park Board; Interdepartmental Committee on Nassella Tussock.

Dr P. J. Garnock-Jones. Treasurer, Organising Committee, International Symposium on Reproduction in Flowering Plants.

Dr E. J. Godley. Hon. Lecturer, Lincoln College; Board of Governors, The Miss E. L. Hellaby Indigenous Grasslands Research Trust; Chairman Editorial Board, New Zealand Journal of Botany; Member, Scientific Co-ordinating Committee for Beech Research; Chairman, Organising Committee, International Symposium on Reproduction in Flowering Plants.

Mr A. J. Healy. Interdepartmental Committee on Nassella Tussock; Canterbury Counties Nassella Tussock Co-ordinating Committee.

Dr P. N. Johnson. Part-time Lecturer in Botany, Otago University; New Zealand Ecological Society, Council Member; Fiordland National Park Board; Working Party, Research Related to Aquatic Weed in Lake Wanaka; Luggate/Queenberry Local Co-ordinating Committee.

Mr G. C. Kelly. Scientific Committee, Marlborough Sounds Maritime Park Board.

Mr M. S. McGlone. New Zealand Working Group (Quaternary) Climatic Change of Australia and New Zealand (CLIMANZ); Holocene Sub-Commission for Australia and New Zealand and Oceania.

Dr N. T. Moar. Scientific Advisory Panel, Arthur's Pass National Park Board; South Island Working Party, Peatlands Policy Study.

Dr B. P. J. Molloy. Member, Peel Forest Park Board; Royal Society of New Zealand (Canterbury Branch) representative on Riccarton Bush Board of Trustees; Member MAB Sub-Commission, New

Zealand National Commission for UNESCO; Member Ashburton Lakes Advisory Committee (Department of Lands and Survey); Member Kowhai River Reserve Scientific Advisory Committee (Marlborough Catchment Board).

Dr G. N. Park. Farewell Spit Scientific Advisory Committee; Hon. Lecturer in Botany, Victoria University.

Dr Melva N. Philipson. Council, New Zealand Rhododendron Association (Inc.).

Mr W. R. Sykes. Nomenclature Committee and Publications Committee, Royal New Zealand Institute of Horticulture; Outlying Islands Reserves Committee; Hanmer State Forest Park Board.

Dr A. D. Thomson, Secretary, New Zealand Genetical Society.

Dr P. Wardle. Board Member and Convener of Scientific Advisory Panel, Westland National Park; Council Member, Royal Society of New Zealand (Canterbury Branch).

Dr P. A. Williams. South Canterbury Catchment Board and Regional Water Board; North Canterbury Nassella Tussock Board.

Dr C. J. Webb. Secretary, Organising Committee, International Symposium on Reproduction in Flowering Plants; Marlborough Nassella Tussock Board.

RETIREMENTS AND RESIGNATIONS

Mr A. J. F. Healy, Scientist from 11.6.46, retired on 14.4.77.

Miss S. M. Griffin, Library Assistant from 28.5.73, resigned on 12.3.76.

Mrs A. L. Olsson, Typist from 3.9.73, resigned on 15.4.76.

Miss P. M. Farrington, Typist from 1.7.74, resigned in April 1976.

Miss G. D. Van Bree, Botanical Artist from 16.6.75, resigned on 18.6.76.

Miss J. K. Burton, Typist from 20.4.76, resigned on 23.6.76.

Miss S. H. Bowman, Technician from 11.8.75, resigned on 13.5.77.

Mrs H. P. Greatrex, Typist from 28.2.77, resigned on 20.5.77.

Miss P. J. Newton, Technician from 17.10.74, resigned on 20.10.77.

Mr S. R. June, Scientist from 27.5.74, resigned on 4.12.78.

STAFF REPLACEMENTS

Mrs B. J. Newburn (née Smith)	1.4.76	Library Assistant (Vice Miss S. M. Griffin).
Miss J. K. Burton	20.4.76	Shorthand Typist (Vice Mrs A. L. Olsson).
Miss R. W. Amer	13.4.76	Typist (Vice Miss P. M. Farrington).

Miss D. L. Bourgeois (née Beetham)	18.8.76	Technician (Vice Mrs L. R. Stephenson, née Stemmer).
Miss R. H. Conway	22.11.76	Botanical Artist (Vice Miss G. D. Van Bree).
Mrs H. P. Greatrex	28.2.77	Typist (Vice Miss J. K. Burton).
Mrs L. M. Williams	18.7.77	Typist (Vice Mrs H. P. Greatrex).
Mrs M. L. Scott	15.8.77	Technician (Vice Miss S. H. Bowman).

NEW POSITIONS

Mr W. G. Lee	2.6.76	Ecologist.
Dr P. N. Johnson	1.10.73	Ecologist.
Miss J. E. Worthington	18.4.77	Field Services Officer.

STAFF NUMBERS AND FINANCE

	1975/76	1976/77	1977/78
Permanent Staff Ceiling	49	50	50
Salaries	$442,600	$483,400	$577,200
Other Expenditure	$127,200	$139,300	$171,400
Total Expenditure	$569,800	$622,700	$748,600
Voted	$551,900	$626,700	$715,900

STAFF LIST

(1.4.78)

DIRECTOR: E. J. Godley, M.Sc. (N.Z.), Ph.D. (Cantab.), Hon. F.L.S., F.R.S.N.Z.

ASSISTANT DIRECTOR:
H. E. Connor, M.Sc. (N.Z.), D.Sc. (Cantuar.)

Headquarters	E. J. Godley, M.Sc. (N.Z.), Ph.D. (Cantab.), Hon. F.L.S., F.R.S.N.Z. A. D. Thomson, M.Sc. (N.Z.), Ph.D. (Cantab.) Mrs D. H. Percy (née Smith)
Botanical Artists	K. R. West R. H. Conway
Administrative Officer	J. A. Coleman

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Library	Mrs M. E. Blackmore Mrs B. J. Newburn (née Smith) Mrs L. Nesbitt (née Gordon)
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Wellington	A. P. Druce, B.E. (N.Z.) I. A. E. Atkinson, M.Sc. (N.Z.), Ph.D. (Hawaii) G. C. Kelly, M.Sc. (Wellington)

South Island	
Lincoln	P. WARDLE, M.Sc. (N.Z.), Ph.D. (Cantab.)
	Mrs M. J. A. BULFIN, B.Sc. (N.Z.), Dip.Hort. (Massey)
	B. P. J. MOLLOY, M.Sc. (N.Z.), Ph.D. (Cantuar.), Dip.Ag. (Massey)
	P. A. WILLIAMS, M.Sc. (Wellington), Ph.D. (Cantuar.)
	A. D. CAMPBELL
Dunedin	P. N. JOHNSON, B.Sc., Ph.D. (Otago)
	W. B. LEE, B.Sc. (Otago), Dip.Sci. (Otago)
	R. B. ALLEN
Nelson	G. N. PARK, M.Sc. (Wellington), Ph.D. (A.N.U.)
	G. Y. WALLS
Palynology and Morphology	N. T. MOAR, M.Sc. (N.Z.), Ph.D. (Cantab.), F.L.S.
	M. S. McGlone, M.Sc. (Wellington)
	R. PATEL, B.Sc. (Vallabh.), M.Sc. (London), Dip. For. (Oxon.)
	Mrs M. N. PHILIPSON, M.Sc. (N.Z.), Ph.D. (Cantuar.)
	E. J. BEUZENBERG, Dip.Trop.Ag. (Deventer)
	J. V. MYERS
	M. K. REYNOLDS, (Electron Microscopist)
	Miss J. E. SHAND

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